INTERNATIONAL STANDARD

ISO 24102-6

First edition
2018-05

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

Part 6: Path and flow management

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

Partie 6: Titre manque

Reference number
ISO 24102-6:2018(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

A list of all parts in the ISO 24102 series can be found on the ISO website.

Introduction

This document is part of a series of International Standards for communications access for land mobiles (CALM). An introduction to this series of International Standards is provided in ISO 21217:2014.

This document is Part 6 of a series of International Standards that specifies path and flow management as part of the local ITS station management.

The ITS station management entity provides functionalities related to the management of communication protocol layers and the security entity presented in the ITS station reference architecture specified in ISO 21217:2014 and presented in Figure 1 — ITS station reference architecture.

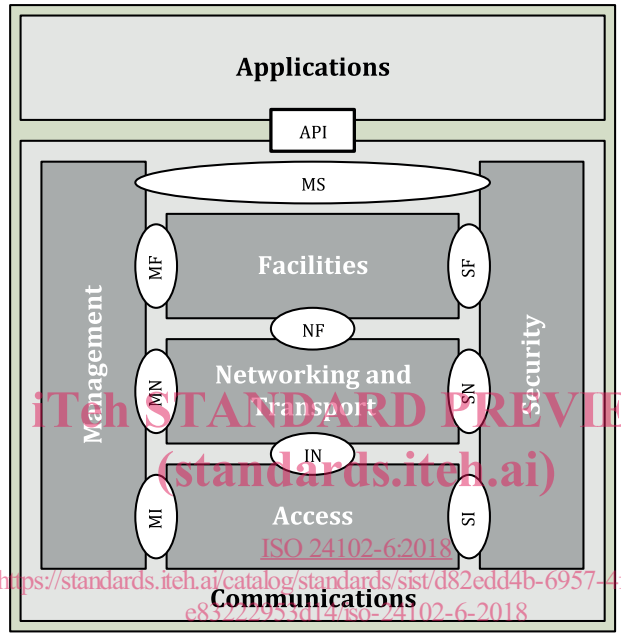

Figure 1 — ITS station reference architecture

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

This document defines the functionalities of the ITS station that are used to collect the information necessary for path and flow management:

— the capabilities of all layers of the ITS station (functionalities, technologies and protocols) supported by the ITS station;

— the capabilities of neighbour ITS stations (functionalities, technologies and protocols) supported by the neighbour ITS stations;

— the current network conditions (availability and characteristics of a communication interface, availability of Internet access, etc.);

— the existing data flows and their communication requirements (identity of the destination node, security procedures applied to the data flow, end-to-end delay, packet size, etc);

— the available routing paths to a destination node;

— how a data flow is mapped to the selected routing path.

The information collected by the ITS station management entity is used to determine the most appropriate communication profile (facilities protocols, transport protocols, network protocols, access technologies and communication channels) and routing path indicating where to route packets of each

data flow, according to the communication requirements provided by the application and depending on the current network conditions. The method to perform this determination has competitive value and is out of scope of this document.

This document provides a detailed specification of the concept of paths and flows introduced in ISO 21217:2014. It complements ISO 17423:2018, ISO/TS 17429:2017, and ISO 24102-3[17]. The concept of paths and flows is essential for abstracting ITS station applications from the communications services available in the ITS station and for selecting the most appropriate communication profile (i.e. protocol stack).

The functionalities specified in this document apply to all types of ITS stations without distinction. They are useful for ITS stations equipped with various access technologies and/or various protocol stacks.

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

Part 6: Path and flow management

1 Scope

This document specifies parameters and procedures for the ITS station management entity to manage data flows and routing paths associated with available communication resources in an ITS station, and to map data flows to routing paths.

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.

ISO 17423:2018, *Intelligent transport systems — Cooperative systems — ITS application requirements and objectives for selection of communication profiles*

ISO/TS 17429:2017, *Intelligent transport systems — Cooperative ITS — ITS station facilities for the transfer of information between ITS stations*

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 http://www.electropedia.org/

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

3.1
anchor node
logical node contained in an ITS-S path which, when instantiated, has a locator known by the source node

3.2
destination node
communication end point of an ITS-S path

Note 1 to entry: In multicast operation, there can be many distinct destination nodes.

3.3
ITS-S egress anchor node
second (last) anchor node contained in an ITS-S path

3.4
ITS-S ingress anchor node
first anchor node contained in an ITS-S path

3.5
ITS-S anchor segment
segment of an ITS-S path that starts at an ITS-S ingress anchor node and ends up at an ITS-S egress anchor node

3.6
ITS-S capability
uniquely addressable protocol or functionality that is part of an ITS-S Managed Service Entity

Note 1 to entry: Examples of ITS-S capabilities in the ITS station facilities layer are generic ITS-S facilities layer services specified in ISO/TS 17429 (Communication Profile Handler, Facilities Services Handler, Content Subscription Handler), the position and time service defined in ISO/TS 21176[1)], the security service defined in ISO/TS 21177[2)]; examples of ITS-S capabilities in the ITS-S networking and transport layer are IPv6 functionalities defined in ISO 21210 (IPv6 neighbour discovery, IPv6 forwarding, IPv6 mobility support, …), the fast service announcement protocol defined in ISO 22418[3)], etc.

3.7
ITS-S communication profile
ITS-SCP
parameterized ITS-S communication protocol stack (set of protocols composing all the ITS station layers) that allows communication end points to communicate with one another

3.8
ITS-S flow
identifiable sequence of packets of a given ITS-S flow type transmitted between a source node and a destination node

3.9
ITS-S flow identifier
FlowID
identifier, being unique within an ITS station unit, that identifies an ITS-S flow

3.10
ITS-S flow type
set of characteristics describing a data flow

Note 1 to entry: Flow types could be pre-assigned, well known and recorded with some authority registry or defined by the applications following a number of conventions

3.11
ITS-S flow type identifier
FlowTypeID
identifier being unique within the ITS station that identifies an ITS-S flow type

3.12
ITS-S path
directed sequence of nodes connected by links starting at a source node, traversing a communication interface of the source ITS-S, an ITS-S ingress anchor node and an ITS-S egress anchor node, ending at a destination node

Note 1 to entry: In some circumstances, the ITS-S ingress anchor node and the ITS-S egress anchor nodes might be collapsed with the destination node (i.e. the roles of the ITS-S ingress anchor node and the ITS-S egress anchor node are played by the destination node).

Note 2 to entry: For bidirectional communications, two such ITS-S paths exist, i.e. one starting at each communication end point. Note further that there could be multiple ITS-S paths between a source and its destination.

---

1) Under development.

2) Under development.

3) To be published.

3.13
ITS-S path identifier
PathID
identifier of a given ITS-S path being unique within an ITS station

3.14
ITS-S managed service entity
MSE
uniquely addressable entity in an ITS-S layer comprised of a set of related ITS-S capabilities

Note 1 to entry: Examples of ITS-S managed service entities are: a communication module in the ITS-S access technologies layer (M5, cellular, etc.), a protocol suite in the ITS-S networking and transport layer (IPv6, FNTP, GeoNetworking, 6LoWPAN, etc.), the generic facilities MSE at the ITS-S facilities layer.

3.15
locator
identifier of the topological location of a node in a communication network

Note 1 to entry: A locator of an ITS station is the identifier of an ITS-S ingress anchor node (an ITS station has as many locators as there are ITS-S ingress anchor nodes to which it is attached).

3.16
registered ITS-S flow
ITS-S flow that has been allocated an ITS-S FlowID

3.17
source node
communication end point that creates packets for transmission to peer entities

4 Symbols and abbreviated terms

CI	Communication Interface, see ISO 21218 [14]
ITS-S-FlowID	ITS Station Flow Identifier
ITS-S-FlowTypeID	ITS Flow Type Identifier
ITS-S	ITS station, see ISO 21217:2014
ITS-S-AP	ITS Station Application Process
ITS-S-APID	ITS Station Application Process Identifier
ITS-SCP	ITS station communication profile
ITS-SCU-CMC	ITS-SCU Communication Management Centre, see ISO 24102-2[16]
MSE	ITS station Managed Service Entity
PathID	ITS station Path Identifier
PFM, pfm	Path and Flow Management
SAL	ITS Station Access Layer
SFL	ITS Station Facilities Layer

SME	ITS Station Management Entity
SNTL	ITS Station Networking and Transport Layer
VCI	Virtual Communication Interface, see ISO 21218[14]

5 Overview

5.1 Relation with the ITS station reference architecture

This document specifies functionalities of the ITS "Station Management Entity" (SME) of the communication architecture specified in ISO 21217:2014. The layered ITS station communication architecture is illustrated in Figure 1 — ITS station reference architecture. The ITS "Station Facilities Layer" (SFL), the ITS "Station Networking & Transport Layer" (SNTL), and the ITS "Station Access Layer" (SAL) are each capable of containing multiple managed service entities (ITS-S Managed Service Entity) running simultaneously as detailed in ISO 21217:2014.

5.2 ITS-S flows

In general, an ITS station supports multiple ITS-S applications of different types such as applications for road safety, traffic efficiency, value added services and infotainment. Each application that needs to send and receive data is most often either engaged in a bidirectional exchange with known communication peers, or is repetitively broadcasting data to unidentified receivers. The nature of the transmitted information is known and communication requirements are typically specific to the type of data flow (road safety, traffic efficiency, infotainment). These communication requirements can be expressed in terms of bandwidth, end-to-end delay, security, packet size, etc. for each type of data flow. A list of requirements is provided in ISO 17423:2018.

The ITS-S flow type allows the classification of data flows with the same characteristics, transmitted from distinct ITS stations or to distinct destination nodes. However, in the common situation in which several applications are installed in a given ITS station unit, these applications are typically engaged in several data exchanges of distinct nature (different flow types). There could consequently exist multiple ongoing data flows of different natures, competing for the same ITS station resources.

5.3 ITS-S communication profiles

In general, an ITS station supports multiple protocols and functionalities (ITS-S capabilities) within each of the ITS station layers: in the ITS-S facilities layer (e.g. the communication handler specified in ISO 17423:2018, ITS-S application processes for CAM[24] and DENM[25],…), various types of ITS-S networking and transport layer protocols (IPv6[8], FNTP [21], GeoNetworking[26],…) and various types and instances of access technologies (communication interfaces[14]).

Available protocols and access technologies can be combined in various ways to transfer data to the destination. A collection of protocols used to transfer data to a destination is referred to as the communication profile (ITS-SCP).

The communication profile indicates the protocol stack, i.e. the protocols at the ITS station facilities layer, the ITS station networking and transport layer, and ITS station access technologies layer that are used for a given data flow.

Several communication profiles could exist to reach a given destination. Some communication profiles may not be appropriate to reach a given destination if the communication end points do not support a compatible set of protocols.

5.4 ITS-S paths

An ITS-S path as defined in ISO 21217:2014 starts at its source node and ends up at a destination node. There may be zero or more intermediate nodes in the ITS-S path between the source node and the destination node.

However, the ITS-S path towards a destination node goes through "selectable communication nodes" that are pre-determined according to the peer nodes engaged in the communication. These "selectable communication nodes" are referred to as the 'ITS-S anchor nodes' (respectively the 'ITS-S ingress anchor node' and the 'ITS-S egress anchor node') and form the entry and exit end points of a controllable path segment ('ITS-S anchor segment'). This is illustrated in Figure 2.

NOTE 1 The CI, the ITS-S ingress anchor node and the ITS-S egress anchor node are the selectable parts of the path. The CI is the starting point of the ITS-S path. The ITS-S ingress anchor node is the first selectable communication node on the path to which the packets are forwarded, whereas the egress ITS-S anchor is the last selectable communication node.

NOTE 2 For groupcast communication, there are multiple destinations but the packets transmitted to a group are not duplicated before reaching the ITS-S egress anchor node, hence all destination nodes are said to be reachable over the same path. The ITS-S egress anchor node can play the role of a rendez-vous point for IP-based multicast communications.

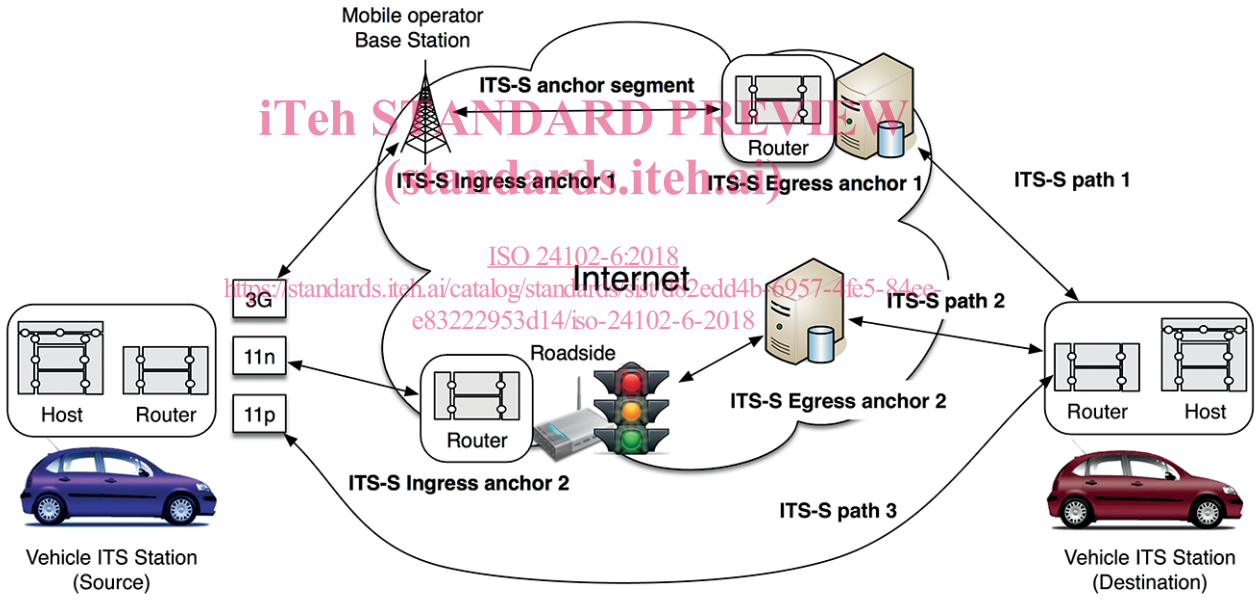

Figure 2 — Overview of the concept of ITS-S path and ITS-S anchor segment

In some circumstances, for example when the source node and the destination node are both located in the same local network (see ITS-S path 3 in Figure 2), the ingress and ITS-S egress anchor nodes are collapsed with the destination node.

— For Internet-based communications (see ITS-S path 1 and 2 in Figure 2), an ITS-S path goes through a communication interface (CI) of the source ITS-S. The ITS-S ingress anchor node is a node in the access network to which the ITS station is locally attached, and the ITS-S egress anchor node is a node in the Internet to which the ITS station is remotely attached. It finally reaches its destination node.

— For local ad hoc communications (see ITS-S path 3 in Figure 2), an ITS-S path goes through a CI of the source ITS-S. The ingress anchor, egress anchor and the destination node are identical.

The diversity of communication interfaces and ITS-S anchor nodes imply a multiplicity of ITS-S paths may be available to reach a given destination node. This happens:

— When multiple ITS-S ingress anchor nodes are reachable through the same communication interface, each of them typically located in the access network of distinct operators or located in different parts of the network when communication traffic is discriminated between road safety, traffic efficiency and infotainment types of services, or when multiple ITS-S ingress anchor nodes are reachable through distinct communication interfaces. Note that ITS-S ingress anchor nodes could be significantly distant in the topology of the communication network (e.g. the ITS-S ingress anchor node on an ITS-S path going through an 11p communication interface of a vehicle ITS station is likely on the roadside infrastructure whereas the ITS-S ingress anchor node on an ITS-S path going through the 3G communication interface is in the network of a cellular operator thus much further away).

— When a diversity of ITS-S egress anchor nodes from the same service operator are deployed in distinct geographic areas or when a diversity of ITS-S egress anchor nodes from distinct service operators provide similar or complementary services.

These ITS-S paths can take very different routes.

5.5 ITS-S capabilities

ITS-S capabilities are used to indicate protocols and functionalities that can be provided by a given ITS-S managed service entity. Each ITS-S capability provides a well-identified function, with some specific characteristics. Each ITS-S capabilitiy has a unique identifier. Well-known ITS-S capabilities may be recorded in a global registry. An ITS-S capability can be provided by several protocols or methods.

At the ITS-S networking and transport layer, examples of ITS-S capabilities in the IPv6 Networking ITS-S managed service entity (`mse-IPv6suite`) are the protocols providing network addressing (IPv6 Stateless Address AutoConfiguration), the protocol providing session continuity (IPv6 mobility support), the protocol providing encryption (IPsec). These ITS-S capabilities of the IPv6 Networking MSE are defined in ISO 21210.

ITS-S capabilities of the generic ITS-S managed service entity in the ITS-S facilities layer (`mse-GISFsuite`) are specified in ISO 17423:2018 (facilities service handler, content subscription handler, communication profile handler), in ISO/TS 21177 [21177] (security service) and ISO/TS 21176[7] (position and time functionality).

5.6 Path and flow management

When there are multiple ITS-S flows and a diversity of communication profiles and ITS-S paths, it is useful to determine for each ITS-S flow:

— The most suitable ITS-S communication profile to transfer data to the destination. This determination is not only necessary for the appropriate use of resources at the sending ITS station, but is also necessary to ensure both communication end points use a compatible set of protocols.

— The most suitable ITS-S path for routing a given ITS-S flow. This determination is not only necessary to route the packets but also to map ITS-S flows to the ITS-S path that best meets the communication requirements of the ITS-S application processes installed on the ITS station.

The determination of the ITS-S path implies the selection of the communication interface, the ITS-S ingress anchor node and ITS-S egress anchor node as shown in Figure 2.

Such determination is made by the ITS station management entity once it has gathered sufficient information on the following categories of information:

— Communication requirements of the applications installed on the ITS station that require communication resources of the ITS station (classified in operational, destination type, performance, monetary cost, energy cost, security, and protocol requirements as specified in ISO 17423:2018).

— Capabilities of all layers of the ITS station (functionalities, technologies and protocols supported by the ITS station, characteristics of available communication interfaces, etc.):

  — Supported ITS station facilities layer protocols (CAM[24], DENM[25], SPaT, MAP, CoAP[6], communication handler, service announcement, generic message handling, local dynamic map[3],...) and their parameters;

  — Supported ITS station network & transport layer protocols (UDP, TCP, FNTP[21], IPv6[8], 6LowPAN[5], GeoNetworking/BTP[26], etc.), the functionalities they provide (broadcasting, multicasting, geocasting, mobility management, multihoming, etc.) and their parameters;

  — Supported ITS station access technologies layer protocols (IEEE 802.11(p)[13][27][28], infrared[12], satellite[23], 2G[10]/3G[11], LTE[2], IEEE 802.15.4[29],...), the functionalities they provide (short range communication, medium range communication, long range communication, ...) and their parameters;

— Capabilities of the access networks to which the ITS station is attached:

  — Network services provided by surrounding neighbour nodes (e.g. vehicle ITS station able to relay information to other vehicles, roadside ITS station providing Internet connectivity, etc.). The ITS station detects neighbour ITS stations and other legacy nodes through network services (neighbour discovery and other mechanisms including signalling protocols) and facilities services (CAM, DENM, SPaT, MAP, SAM, ...). For instance, among the services of neighbour ITS stations detected from network layer signalling protocols, a neighbour ITS station may provide a network access service allowing the ITS station to access the Internet while another may provide an anchor service;

  — Current network conditions: various metrics of an access technology (bandwidth, packet loss), status of link (set up, in use, ...), network load, reachability over that link (availability of Internet access);

— Capabilities of the peer communication end points as they must be able to support the same communication profiles;

— Capabilities of the ITS-S anchor nodes along the ITS-S path;

— Regulations and policies including local, national and regional rules (e.g. allowed access technologies and their transmission power; location privacy) and stakeholder rules (e.g. always prefer one access technology over another).

Figure 3 illustrates the architectural components (building blocks and management data flows) of the ITS station management entity which are involved in the ITS-S path selection process. The same architecture applies to the communication profile selection process introduced in ISO 17423:2018.