
**Cooperative intelligent transport
systems (C-ITS) — Guidelines on the
usage of standards —**

**Part 1:
Standardization landscape and
releases**

*Systèmes de transport intelligents coopératifs (C-ITS) - Lignes
directrices sur l'utilisation des normes —*

Partie 1: Paysage de la normalisation et diffusions

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

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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 of 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 www.iso.org/iso/foreword.html.

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

A list of all parts in the ISO 21186 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is part of a family of deliverables from Standard Development Organizations (SDOs) for Cooperative Intelligent Transport Systems (C-ITS), which is a subset of standards for Intelligent Transport Systems (ITS).

ITS aims to improve surface transportation in terms of:

- **safety**
e.g. crash avoidance, obstacle detection, emergency calls, dangerous goods;
- **efficiency**
e.g. navigation, green wave, priority, lane access control, contextual speed limits, car sharing;
- **comfort**
e.g. telematics, parking, electric vehicle charging, infotainment;
- **sustainability**

by applying information and communication technologies (ICT).

The whole set of standards for deployment of C-ITS is difficult to understand by developers of equipment and software, especially ITS application software, and thus guidelines explaining a beneficial choice of standards (C-ITS Release), the purpose and interaction of standardized features, beneficial implementation approaches and guidance in developing ITS applications are a prerequisite for a fair and open market allowing early deployment of interoperable and future-proof solutions.

The ISO 21186 series provides necessary guidelines in multiple parts, each dedicated to a specific purpose:

- Part 1: Standardization landscape and releases (this document);
- Part 2: Hybrid communications^[32];
- Part 3: Security^[33].

This document can be complemented by further parts as required, for example:

- Usage of the service announcement protocol specified, for example, in ISO 22418;
- Dynamically extendable data and protocol parameters ("Information Object Classes" and "Information Object Sets"; based on ASN.1 type CLASS);
- Usage of the GTDM framework specified in ISO/TS 21184.

For deployment of ITS, especially C-ITS and the emerging Urban ITS and "Mobility as a Service" (MaaS) paradigms, consistent and complete sets of standards and profiles of standards including necessary parameterization are necessary in support of the targeted ITS services to be provided by means of ITS applications. Such sets are referred to as "C-ITS Release". This document presents the C-ITS standards landscape, describes a concept of Releases and exemplifies this concept with a "C-ITS Release 2".

At the time of writing this document, no applicable Intellectual Property Rights (IPR) issues were known related to this document. However, this document references standards, for which IPRs are known. Information on such IPRs is expected to be provided in those respective standards, which might be from any one of the Standards Development Organisations working on ITS or C-ITS.

Referencing other SDOs and their respective deliverables is in no way to be understood as an endorsement, but rather as an informative piece of information.

More details on the C-ITS domain can be found in the Brochure cited in Reference [\[129\]](#).

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Cooperative intelligent transport systems (C-ITS) — Guidelines on the usage of standards —

Part 1: Standardization landscape and releases

1 Scope

This document

- describes standardization activities related to C-ITS on a global level by major standard development organizations (SDOs);
- explains the various purposes of deliverables from SDOs and introduces a classification scheme of such documents;
- describes methods on how C-ITS services are presented and performed;
- identifies an approach for C-ITS releases and exemplifies this approach;
- presents a list of standards (Bibliography) with special relevance for C-ITS.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

NOTE An approach towards a common vocabulary in ITS is presented in ISO/TS 14812¹⁾.

4 Standardization at SDOs

4.1 General

Standardization in general is the process of generating specifications by a recognized authority, i.e. an SDO, applying the principle of consensus finding prior to formal approval by voting according to the rules of the SDOs.

Regulatory requirements complement standards and specifications and should be considered for the deployment of equipment and the operation of services in the given regulatory domain.

1) Under preparation. Stage at time of publication: ISO/DTS 14812:2021.

4.2 Goals of standardization

The purpose of standardization, in general, is to enable or facilitate services of the respective standardization domain, i.e. C-ITS services provided by ITS applications for the ITS service domains. Particularly, the purpose of standardization is manifold, for example, aiming at:

- technical interoperability at observable communications interfaces (covering, for example, mechanical, electrical, and logical requirements);
- portability of applications (enabling, for example, the online download of applications from station management centres and the execution of them on different technical platforms);
- syntactical and semantical interoperability in terms of data and messages;
- minimum functionality from the users' point of view;
- minimum performance to ensure reliable execution of use-cases;
- facilitation of implementations;
- reliable protected operations in terms of privacy and (cyber) security;
- provision of commonly agreed terms and definitions, i.e. a common language;
- commonly agreed modes of operation, i.e. work methods;
- a global market;
- prevention of vendor-lock-in; and
- evidence of compliance.

An introduction to C-ITS services is provided in [Clause 5](#).

4.3 Releases

In order to reach the standardization goals listed in [4.2](#), standards are grouped in so-called "Releases", together with information on profiles and parameters. Profiles identify selected mandatory requirements, and parameter information identifies applicable values, such that interoperability between equipment provided by different vendors is ensured.

Releases use dated references to standards. A release supports one or several use cases or services.

The Bibliography presents a non-exhaustive snapshot of SDO deliverables that are considered to be of certain relevance for ITS, especially for C-ITS but also for the Urban ITS paradigm.

[Clause 6](#) explains the approach towards C-ITS releases and provides examples of releases.

4.4 SDOs

Major standard development organizations (SDOs), e.g. ISO, CEN, ETSI, IEEE, working on an international or regional level provide deliverables, e.g. standards, specifications, reports, for the domain of C-ITS.

Secondary SDOs in the sense of the C-ITS business domain are working on general purpose specifications that are usually referenced in ITS standards.

For the deployment of ITS, regional legislation is to be considered, e.g. in Europe:

- Decisions of the European Commission;
- Recommendations and Decisions from CEPT's ECC / ERC;
- Delegated Acts of the European Commission.

More details on "who is doing what" are presented in the Brochure^[129].

4.5 Standardization areas

Standardization activities can be grouped into standardization areas. For the purpose of this document, this grouping follows largely the ITS station architecture specified in ISO 21217 and illustrated in [Figure 1](#).

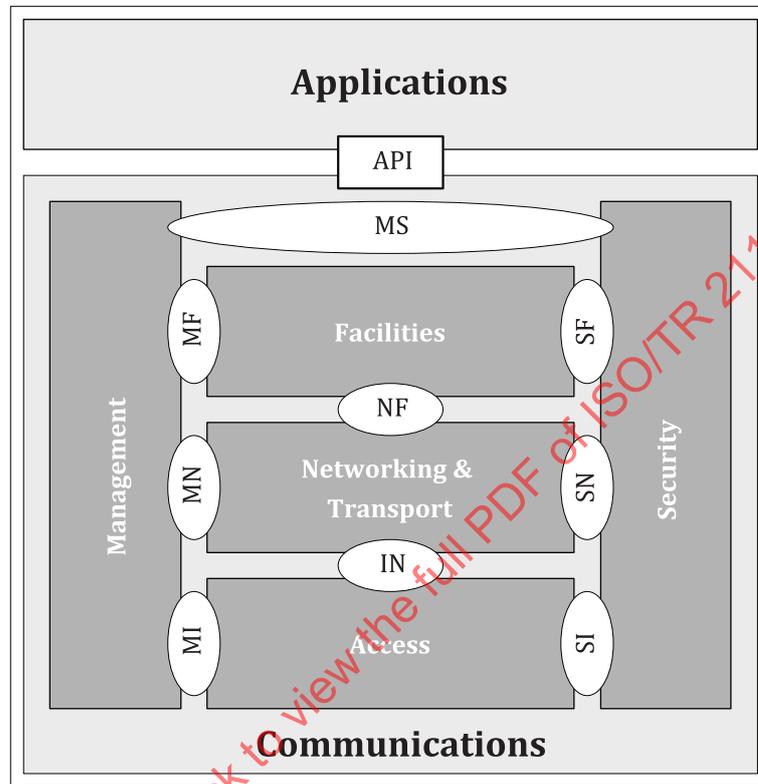


Figure 1 — Simplified ITS station architecture (ISO 21217)

The "Harmonized Architecture Reference for Technical Standards" (HARTS) project applied the same architectural approach using slightly different terms^[128].

The following standardization areas are identified and used in this document:

— **A-1: System level issues**

High level system architecture and related issues, i.e. the environment in which ITS-SUs according to [Figure 1](#) operate.

— **A-2: Station architecture**

Primarily the general framework illustrated in [Figure 1](#).

— **A-3: ITS applications, messages, data**

Issues related to use cases and related applications (procedural behaviour) and their respective communications (data and messages) that are typically architecturally located in the Applications and Facilities blocks of [Figure 1](#).

— **A-4: Station management**

Management of issues related to whole ITS-SU covering e.g. local station management and remote station management.

— A-5: Security

Issues mainly architecturally located in the Security block of [Figure 1](#); these issues include interactions between the Security block and basically all other blocks of [Figure 1](#). Note that security also includes privacy.

— A-6: Access layer technologies

Communications issues architecturally located in the Access block of [Figure 1](#), i.e. the functionality of the OSI layers 1 and 2.

— A-7: Network and Transport layer technologies

Communications issues architecturally located in the Networking and Transport block of [Figure 1](#), i.e. the functionality of the OSI layers 3 and 4.

— A-8: Facility layer technologies

Issues related to communications and applications, architecturally located in the Facilities block of [Figure 1](#), i.e. the functionality of the OSI layers 5, 6, and 7.

— A-9: Protocol stack

Issues related to a combination of A-6, A-7, and A-8.

Within each standardization area, possible subjects of an SDO deliverable are distinguished by means of categories of SDO deliverables; see [4.6](#).

4.6 Categories of SDO deliverables

The following standards categories, applicable for the various standardization areas presented in [4.5](#), are identified and used in this document:

— C-1: Preparatory investigations

The major topic is the provision of results on investigations aiming on identifying potential future standardization activities.

— C-2: Functional requirements

The major standardization topic is the provision of functional requirements without going into the details of specifications of e.g. protocols, data, or messages.

— C-3: Use cases

The major standardization topic is the provision of use case specifications and related illustrations.

— C-4: Data and messages

The major standardization topic is the provision of definitions of data, also referred to as "data dictionaries", or the specification of messages, typically based on standardized data.

— C-5: Protocols

The major standardization topic is the provision of protocol specifications, e.g. communications protocols and procedural behaviour of applications.

— C-6: Profiles

The major standardization topic is the provision of profiles based on existing standards, e.g. a communication profile^[38] based on the tool box IEEE 802.11^[112] (WiFi).

— C-7: Testing

The major standardization topic is the provision of test specifications, e.g. conformance test suites. Conformance test suites typically consist of three parts, i.e.

- 1) a (Protocol) implementation conformance statement proforma (PICS) allowing a vendor to declare conformance with selected features;
- 2) a test suite structure and test purposes (TSS&TP) document providing a natural-language description of tests to be performed dependent on the PICS declaration;
- 3) an abstract test suite (ATS) providing test software (typically written in TTCN-3) to be executed dependent on the PICS declaration.

— C-8: Regulations

The major topic is the provision of information on applicable regulations. Note that such information is not usually provided in standards, whilst standards (e.g. Harmonized European Norms) are referenced by regulation.

— C-9: Registries

The major topic is the provision of registration information, e.g. a registry of OSI layer port numbers for a specific transport protocol, or a registry for globally unique ITS application identifiers (ITS-AID).

— C-10: Tutorials and guidelines

The major topic is the provision of tutorials on technical topics and guidelines on how to apply standards; an example is this document.

— C-11: Reports

The major topic is the provision of non-normative information, and are largely different to tutorials and guides, e.g. validation reports on conformance testing and security analysis (TVRA).

— C-12: Research

The major topic is the provision of results on scientific research related to potential future standardization.

— C-13: Process

The major standardization topic is the provision of process specifications, e.g. business processes.

NOTE SDO deliverables can provide specifications related to various categories.

5 C-ITS services

5.1 General

C-ITS services are services from ITS service domains that are based on the concept of cooperation. The concept of cooperation, i.e. C-ITS, is explained in the Brochure^[129].

There exist approaches to identify ITS services and ITS use cases. However:

- a) there is no consensus on a harmonized academic approach,
- b) there are different regional needs and approaches, and
- c) finally, it is proving difficult or even impossible to have any hierarchically structured presentation at all.

ISO/TR 21186-1:2021(E)

Three examples of approaches are presented below. This document does not use any one of these approaches, but instead considers a "flat space" of C-ITS services.

The first example of such an approach is given by ISO 14813-1, presenting the following ITS service domains:

- Traveller Information;
- Traffic Management and Operations;
- Vehicle Services;
- Freight Transport;
- Public Transport;
- Emergency Services;
- Transport-related Payment;
- Road transport related Personal Safety;
- Weather and Environmental Conditions Monitoring;
- Disaster Response Management and Coordination;
- National Security;
- ITS Data Management; and
- Performance Management.

A second international approach to identify ITS services was performed by the Harmonization Task Group 7 with contributions from Australia, the European Union, and the United States of America. This approach resulted in the "Harmonized Architecture Reference for Technical Standards" (HARTS) which is presented at <http://htg7.org/>. HARTS identified the following ITS service packages:

- Advanced Traveller Information Systems – Broadcast and Personalized;
- Connected Vehicle System Monitoring and Management;
- Core Authorization;
- Curve Speed Warning;
- Data Distribution;
- Eco-Approach and Departure at Signalized Intersections;
- Electric Charging Stations Management;
- Electronic Regulations;
- Emergency Vehicle Pre-emption;
- Freight Signal Priority;
- Intelligent Traffic Signal System;
- Intersection Safety Warning and Collision Avoidance;
- In-Vehicle Signage;
- Location and Time;

- Map Management;
- Object Registration and Discovery;
- Pedestrian in Signalized Crosswalk Warning;
- Privacy Protection;
- Queue Warning;
- Railroad Crossing Violation Warning;
- Reduced Speed Zone Warning / Lane Closure;
- Security and Credentials Management;
- Situational Awareness;
- Smart Park and Ride System;
- Special Vehicle Alert;
- Speed Harmonization;
- Spot Weather Impact Warning;
- Stop Sign - "Gap Assist" and "Violation Warning";
- Transit Signal Priority;
- Traveller Information - Smart Parking;
- V2V Basic Safety;
- Vehicle Data for Traffic Operations; and
- Warnings about Upcoming Work Zone.

A third example is an approach linked to the international HARTS work, i.e. the "Architecture Reference for Cooperative and Intelligent Transportation" (ARC-IT) of the United States of America. This approach is presented at <http://localiteris.com/arc-it/>. ARC-IT identifies C-ITS Service Packages grouped into the following areas:

- Commercial Vehicle Operations;
- Data Management;
- Maintenance and Construction;
- Parking Management;
- Public Safety;
- Public Transportation;
- Support;
- Sustainable Travel;
- Traffic Management;
- Traveller Information;
- Vehicle Safety;

— Weather.

It is to be noted that several even non-interoperable instantiations of the same ITS service can exist.

(C-)ITS services are provided by ITS applications, and ITS applications are implemented by means of complementary ITS-S application objects; see ISO 21217.

ITS-S application objects, in the terminology of the OSI layered model specified in ISO/IEC 7498-1, are software entities typically located above the OSI communications protocol stack that can interact with one or several peer stations for exchanging Application Protocol Data Units (APDUs) - either receive, or transmit, or receive and transmit. Further on, an ITS-S application process can exchange locally (same ITS station unit [ITS-SU]) data with other ITS-S application processes or facilities (e.g. PVT service specified in ISO/TS 21176, or the message and data management facilities specified in ISO/TS 17429 and ISO/TS 21184²⁾). The processing of these APDUs and data finally provides the ITS service to the user of ITS. The user of ITS can be a human or a machine.

Basically, ITS applications and their related ITS-S application processes are agnostic to communications technologies. However, ITS applications can require certain communication capabilities which, together with regional regulations and system specification requirements (policies), allow selecting specific communication protocol stacks per flow of an ITS-S application process. Respective applicable management standards are ISO 17423 and ISO 24102-6. This leads to the concept of Hybrid Communications which is explained in ISO/TS 21186-2.

Service initiation and provisioning is explained in [5.2](#).

5.2 Service initiation and provisioning

5.2.1 Services for information dissemination based on broadcast messages

In the context of road safety, C-ITS services are mainly based on broadcasting standardized messages, i.e. there are:

- a) ITS-S application processes for assembling such messages (e.g. CAM, DENM, SPaT, IVI, BSM, ...) on the basis of input data, e.g. from sensor and control networks.
- b) ITS-S application processes for parsing and disassembling of such messages and provisioning of data contained in these messages to either a local dynamic map (LDM) specified in ISO 18750 or to interested other local ITS-S application processes using a publish-subscribe mechanism (ISO/TS 17429)
- c) ITS-S application processes for processing received data and performing related actions such as:
 - information to the human user;
 - interaction with the vehicle (currently via assistance systems, in the future directly to the autonomous vehicle).

NOTE An incomplete overview of acronyms used in C-ITS is presented in the Brochure^[129].

Examples for the above three cases are:

- a) The CAM (Cooperative Awareness Message) Generator application consists of a single ITS-S application process. Generation of a CAM is a service provided to CAM parsers in peer ITS-SUs, i.e. not provided directly to humans.
- b) The CAM Parser application consists of a single ITS-S application process. Parsing of CAMs and provisioning of these messages or parts of them is a service provided to other ITS-application processes in the same ITS-SU, i.e. not provided directly to humans.

2) Under preparation. Stage at time of publishing: ISO/PRF TS 21184:2021.

- c) Various ITS applications in an ITS-SU can depend on information from CAMs. The respective ITS-S applications receive CAM data either via a direct publish-subscribe method or from the LDM (i.e. typically not directly from peer stations), process these data, and perform actions in support of humans as explained above (i.e. provide C-ITS services to humans). Note that such ITS applications are typically not standardized in detail, but are specified by vehicle manufacturers and aftermarket service providers.

5.2.2 Services based on service announcement

5.2.2.1 Service announcement

Service announcement is specified in ISO 22418. It uses localized communication, e.g. IEEE 802.11^[112] OCB at 5,9 GHz, to announce ITS services together with advice on how to get access to these services (communication protocol stack, frequency channel, etc.). The essential messages are the Service Advertisement (or "Announcement"; both terms are used) Message (SAM), typically periodically transmitted by a roadside station, and the conditional Service Response Message (SRM) acknowledging a SAM dependent on details in the SAM.

Available ITS services are identified by a globally unique registered ITS Application Identifier (ITS-AID) specified in ISO 17419.

NOTE The "Provider Service Identifier" (PSID) specified by IEEE is identical with ITS-AID. The two terms are used synonymously.

5.2.2.2 Information services

A SAM can contain the complete information package for a given ITS-AID. However, in general, the SAM just indicates how a station can connect to the information dissemination station. Using this feature opens a possible security threat, which is currently under discussion with respect of a revision of ISO/TS 16460.

5.2.2.3 Session-based services

A SAM can identify a service, and service provisioning will be based on a session. Such sessions can be performed with localized communications with optional switching to another radio channel (still using IEEE 802.11^[112] OCB, for example), or by switching to another access technology, e.g. cellular networks, infrared communications, ultra wideband communications, ordinary WiFi, and performing an IP-based session.

One example is installed already in large scale, i.e. the electronic road tolling service in Europe operated at 5,8 GHz using the CEN DSRC protocols rather than ISO 22418.

A further example is the remote interrogation of the European Digital Tachograph in heavy vehicles using also the CEN DSRC protocols, see also ISO 4426³⁾.

5.2.2.4 Voluntary vs. mandatory services

Whereas many ITS services that will be announced using the mechanisms of ISO 22418 are voluntary ITS services, some of the announced ITS applications - and likely this will be a growing number - will be flagged as "mandatory". That means that usage of an ITS service is required by regulation or policies as a prerequisite for a specific usage of the transport infrastructure. An example is a mandatory parking and booking guide service of a city, without which parking in the city is prohibited. When an ITS-SU receives the announcement of such a mandatory ITS service, it has to download it, e.g. from its ITS-SCU configuration management centre (ISO 24102-2), and implement it, if it is not yet implemented.

Voluntary ITS services can be free of charge or can be services provided by third parties as "paid premium services": details are out of scope of this document.

3) Under preparation. Stage at time of publication: ISO/DIS 4426:2021.

5.2.3 Services initiated by a central station

Applying the principles of mobile IPv6 (e.g. using a home agent as specified in ISO 21210), central stations can directly connect mobile stations using Internet connectivity over e.g. cellular networks or even ordinary WiFi. Both types of services, i.e. information dissemination services and session-based services, e.g. remote ITS station management, are possible.

5.3 Use cases

A specific execution of an ITS application for a specific ITS service in a particular context with a specific purpose is referred to as an ITS use case.

The first "standardized" identification of ITS Applications was undertaken by ETSI in TR 102 638^[82]; this document aimed to define a "Basic Set of Applications" to be part of the ETSI C-ITS Release 1 (see 6.3). Seven ITS Applications arranged in four groups with a total of 32 ITS use cases were identified. This methodology was subsequently not fully adopted, e.g. the ITS use case "Roadwork warning" (RWW) being part of the ITS Application "Driver Assistance - Road Hazard Warning" of the group "Active road safety" was referred to as ITS Service "Road Works Warning" with a number of use cases in the EU C-ITS Corridor project.

This shows that the naming and grouping undertaken by different organizations and projects reflects academic approaches that do not need being taken too seriously; see also 5.1. Nevertheless, ETSI TR 102 638, with its graphical illustrations, is very beneficial for understanding use cases.

Obviously, the various stakeholders have different opinions on the basic choice and the prioritization of ITS services and use cases. Vehicle manufacturers mainly focussed on:

- car-to-car communications and crash-avoidance, and
- car-to-cloud communications for commercial services ("Extended Vehicle" concept standardized in ISO/TC 22),

whereas road administrations focussed on improved traffic management and smooth traffic flow.

6 Releases

6.1 Disclaimer

This document does not normatively specify a C-ITS Release, but rather describes the concept of Releases, presents known C-ITS Releases from the European Union, and specifies an example of a C-ITS Release 2 applicable for initial C-ITS services known as, for example, day-1 services, and future C-ITS services as are currently being considered in various projects.

6.2 Concept of releases

The term "release" is used for many different purposes. Its original generic meaning is "publication". For the purpose of this document, the term "release" means:

- publication of information by an authority;
- where different publications of the same authority are distinguished by
 - name;
 - publication date; and
 - version number;
- with this information being a set of consistent (profiles of) dated specifications and standards;

- with this information optionally being complemented by necessary parameterization;
- with this information being intended for a specific usage; and
- with this information being in support of deployment of equipment and services.

In short form, a release is defined as a publication of information - identified by a name, a date, a version number - on a consistent set of (profiles of) dated specifications and standards including necessary parameterisation by an authority for a specific usage in support of deployment of equipment and services.

A "C-ITS release" is thus a release where the specific usages are selected C-ITS services.

Authorities defining "C-ITS releases" are, for example:

- SDOs;
- industry interest groups;
- public (governmental) authorities; or
- regulatory bodies.

Whether a C-ITS release has any legal impact on the deployment and operation of C-ITS depends on:

- who the authority is that issues a C-ITS release;
- whether a published C-ITS release is approved by a legal authority;
- whether the related C-ITS services are legally mandatory (in a given region) or are optional.

However, it is to be noted that usage of specific transportation corridors, e.g. toll roads, bridges, tunnels, operated by private companies can require that vehicles using such a corridor be equipped according to a C-ITS release published or referenced by the private operator. Such a private operator is the authority for his/her road network and the offered transportation service. In case a manufacturer of a vehicle does not support such a required C-ITS release with his/her built-in C-ITS equipment, after-market C-ITS equipment is used, including all necessary interfaces to required vehicle-internal entities.

6.3 Management of releases

Management of releases containing standards and specifications from a single SDO follows the release procedures as specified by the respective SDO. An example is the approach in ISO/TC 204 illustrated in ISO/TR 17465-3; another example is the approach applied by 3GPP.

A C-ITS release, however, goes beyond a release from a single SDO, as C-ITS builds on standards and specifications from various SDOs, potentially also including industry specifications. Thus, the C-ITS Release Procedure is more complex than an ordinary release, e.g. such as those from 3GPP.

Typical important elements of a release procedure include:

- identification of a responsible release co-ordinator representing the authority introduced in 6.2;
- identification of the intended services to be enabled by the given release;
- identification of a release date, at which the release is published and can be used;
- selection of applicable and available dated standards and specifications in support of the identified services;
- identification of profiles of the selected standards, if needed to ensure interoperability;
- identification of gaps in specifications and standards, that need standardization activities in a timely manner in order to keep the release date.

6.4 Examples of existing C-ITS releases

Two published examples of C-ITS releases were:

- a) the "C-ITS release 1" requested by the European Commission as part of the standards development under mandate M/453^[123] by ETSI TC ITS and CEN/TC 278;
- b) the respective Annex 2 of the draft C-ITS Delegated Act from the European Commission^[124].

"C-ITS release 1" consisted of two independent lists of standards, partly with different versions of the same standard, and partly with standards under development, where one list was from CEN, and one list was from ETSI. Consequently, this "C-ITS release 1" is not a release in the meaning of the definition given in this document.

The respective annex of the C-ITS Delegated Act was formally useful as a release in the meaning of the definition of this document. However, this C-ITS Delegated Act was finally rejected by the European Council in 2019, requesting the European Council to prepare for a new C-ITS Delegated Act documentation. This Release contained the following standards dedicated to C-ITS, together with an unexpected large amount of parameterization, especially related to GeoNetworking:

- ISO/TS 19091;
- ISO/TS 19321;
- ETSI EN 302 636-4-1;
- ETSI EN 302 636-5-1;
- ETSI EN 302 637-2;
- ETSI EN 302 637-3;
- ETSI EN 302 663;
- ETSI EN 302 931;
- ETSI TS 102 636-4-2;
- ETSI TS 102 687;
- ETSI TS 102 724;
- ETSI TS 102 792;
- ETSI TS 102 894-1;
- ETSI TS 102 894-2;
- ETSI TS 103 097;
- ETSI TS 103 248;
- ETSI TS 103 301;
- ISO 14816;
- ISO/TS 14823⁴⁾;
- SAE J2945/1.

NOTE A short presentation and evaluation of the above listed standards is provided in the Brochure^[129].

4) This is a standard of general applicability, not dedicated to C-ITS.

6.5 C-ITS release 2 from CEN and ISO

6.5.1 General

In what follows, a C-ITS release 2 is composed that considers standards from all relevant SDOs that are so far engaged in C-ITS standardization.

Usage of this release:

- Future-proof manageable C-ITS equipment;
- Enabling interoperable equipment;
- Support of hybrid communications;
- Enabling portability of ITS applications and agnosticism of such applications with respect to communications;
- C-ITS services that are considered in the rejected C-ITS Delegated Act;
- Additional C-ITS services that are currently being proposed, tested and deployed in various regions, e.g.
 - C-Roads;
 - NordicWay;
 - Intercor.

The C-ITS Release 2 is presented in a structured way, applying a clustering based on the standardization areas introduced in [4.5](#).

6.5.2 Release identification

- Name: C-ITS Release
- Publication date: Date of publication of this document
- Version number: 2

6.5.3 Supported C-ITS services

A large number of C-ITS services is identified by various projects. Considering cross-border traffic, a vehicle ITS-SU beneficially supports a larger set of C-ITS services than just those identified for the home region.

C-ITS services that can be supported by this release include:

- a) Basic services provided by ITS-S facilities to C-ITS services:
 - 1) Cooperative awareness service;
 - 2) Decentralized event notification service;
 - 3) Traffic semaphore service;
 - 4) In-vehicle signage service;
 - 5) Service announcement service;
- b) and a set of C-ITS services not specified further in this document.

6.5.4 Standards cluster

The standards presented in this cluster are distinguished by their purposes:

- P1: enabling interoperability;
- P2: ensuring minimum set of functionalities;
- P3: ensuring minimum performance;
- P4: enabling portability of applications;
- P5: supporting future-proof implementation of station-internal features;
- P6: architectural and functional description and specification;
- P7: testing;
- P8: other purposes.

See also the goals of standardization presented in [4.2](#).

NOTE A certain functionality can be implemented in different ways, even in non-interoperable ways. Non-interoperable ways of implementing a functionality are acceptable in case the different ways of implementation are required by regional regulations or laws; that is, conformance with the release in a given regulatory domain.

Conformance with a release requires, as a minimum, conformance with those (parameterized) standards or profiles of standards that are needed for the purposes P1, P2, P3, and P4, and applying respective test standards (P7).

[Figure 2](#) shows an overview of standards of C-ITS Release 2. Details are presented in the Brochure^[129].

Bibliography

ISO Standards

- [1] ISO 4426⁵⁾, *Intelligent transport systems — Lower layer protocols for usage in the European digital tachograph*
- [2] ISO/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*
- [3] ISO 14812⁶⁾, *Intelligent transport systems — Vocabulary*
- [4] ISO 14813-1, *Intelligent transport systems — Reference model architecture(s) for the ITS sector — Part 1: ITS service domains, service groups and services*
- [5] ISO 14816, *Road transport and traffic telematics — Automatic vehicle and equipment identification — Numbering and data structure*
- [6] ISO 14823, *Intelligent transport systems — Graphic data dictionary*
- [7] ISO 14906, *Electronic fee collection — Application interface definition for dedicated short-range communication*
- [8] ISO 15628⁷⁾, *Intelligent transport systems — Dedicated short range communication (DSRC) — DSRC application layer*
- [9] ISO/TS 16460^{8),9)}, *Intelligent transport systems — Communications access for land mobiles (CALM) — Communication protocol messages for global usage*
- [10] ISO 16461, *Intelligent transport systems — Criteria for privacy and integrity protection in probe vehicle information systems*
- [11] ISO 17419¹⁰⁾, *Intelligent Transport Systems — Cooperative Systems — Globally unique identification*
- [12] ISO 17423:2018¹¹⁾, *Intelligent Transport Systems — Cooperative Systems — Application requirements and objectives*
- [13] ISO/TS 17425¹²⁾, *Intelligent transport systems — Cooperative systems — Data exchange specification for in-vehicle presentation of external road and traffic related data*
- [14] ISO/TS 17426¹³⁾, *Intelligent Transport Systems — Cooperative Systems — Contextual speeds*
- [15] ISO 17427-1¹⁴⁾, *Intelligent Transport Systems — Cooperative ITS — Part 1: Roles and responsibilities in the context of co-operative ITS architecture(s)*

5) Under preparation. Stage at time of publication: ISO/DIS 4426:2021.

6) Under preparation. Stage at time of publication: ISO/DTS 14812:2021.

7) A technically equivalent standard exists from CEN: EN 12834.

8) Specifies messages harmonized with IEEE 1609.3.

9) Under revision and upgrade to ISO 16460.

10) Under Vienna Agreement: EN 17419:2018.

11) Under Vienna Agreement: EN 17423:2018.

12) Under Vienna Agreement: CEN TS 17425:2016.

13) Under Vienna Agreement: CEN TS 17426.

14) Under Vienna Agreement: EN 17427-1.

- [16] ISO/TS 17429^{15),16)}, *Intelligent transport systems — Cooperative ITS — ITS station facilities for the transfer of information between ITS stations*
- [17] ISO 17465-3, *Intelligent transport systems — Cooperative ITS — Part 3: Release procedures for standards documents*
- [18] ISO 17515-1, *Intelligent transport systems — Communications access for land mobiles (CALM) — Evolved-universal terrestrial radio access network (E-UTRAN) — Part 1: General usage*
- [19] ISO 17515-3, *Intelligent transport systems — Evolved-universal terrestrial radio access network — Part 3: LTE-V2X*
- [20] ISO 18750^{17),18)}, *Intelligent transport systems — Co-operative ITS — Local dynamic map*
- [21] ISO 19414, *Intelligent transport systems — Service architecture of probe vehicle systems*
- [22] ISO/TS 19091¹⁹⁾, *Intelligent transport systems — Cooperative ITS — Using V2I and I2V communications for applications related to signalized intersections*
- [23] ISO 19079, *Intelligent transport systems — Communications access for land mobiles (CALM) — 6LoWPAN networking*
- [24] ISO 19080, *Intelligent transport systems — Communications access for land mobiles (CALM) — CoAP facility*
- [25] ISO/TS 19321²⁰⁾, *Intelligent transport systems — Cooperative ITS — Dictionary of in-vehicle information (IVI) data structures*
- [26] ISO/TS 20026, *Intelligent transport systems — Cooperative ITS — Test architecture*
- [27] ISO 20922, *Information technology — Message Queuing Telemetry Transport (MQTT)*
- [28] ISO/TS 21176²¹⁾, *Cooperative intelligent transport systems (C-ITS) — Position, velocity and time functionality in the ITS station*
- [29] ISO/TS 21177²²⁾, *Intelligent transport systems — ITS station security services for secure session establishment and authentication between trusted devices*
- [30] ISO/TS 21184^{23),24)}, *Cooperative intelligent transport systems (C-ITS) — Global transport data management (GTDM) framework*

15) Under Vienna Agreement: CEN TS 17429.

16) Under revision with split into a multi-part document: *Cooperative intelligent transport systems (C-ITS) — ITS station facility services*

— *Part 1: Communication profile handler*

— *Part 2: Facility services handler*

— *Part 3: Content subscription handler*

17) Under Vienna Agreement: EN 18750.

18) Includes EN 302 895, and additionally provides PICS for conformance testing.

19) Under Vienna Agreement: CEN/TS 19091.

20) Under Vienna Agreement: CEN TS 19321.

21) Under Vienna Agreement: ISO/TS 21176.

22) Under Vienna Agreement: CEN/TS 21177.

23) Under preparation. Stage at time of publication: ISO/PRF TS 21184:2021.

24) Under Vienna Agreement: ISO/TS 21184.

- [31] ISO/TS 21185²⁵⁾, *Intelligent transport systems — Communication profiles for secure connections between trusted devices*
- [32] ISO/TS 21186-2, *Cooperative intelligent transport systems — Guidelines on the usage of standards — Part 2: Hybrid communications*
- [33] ISO/TR 21186-3²⁶⁾, *Cooperative intelligent transport systems (C-ITS) — Guidelines on the usage of standards — Part 3: Security*
- [34] ISO 21210²⁷⁾, *Intelligent transport systems — Communications access for land mobiles (CALM) — IPv6 Networking*
- [35] ISO 21212, *Intelligent transport systems — Communications access for land mobiles (CALM) — 2G Cellular systems*
- [36] ISO 21213, *Intelligent transport systems — Communications access for land mobiles (CALM) — 3G Cellular systems*
- [37] ISO 21214, *Intelligent transport systems — Communications access for land mobiles (CALM) — Infra-red systems*
- [38] ISO 21215²⁸⁾, *Intelligent transport systems — Localized communications — ITS-M5*
- [39] ISO 21217, *Intelligent transport systems — Station and communication architecture*
- [40] ISO 21218, *Intelligent transport systems — Hybrid communications — Access technology support*
- [41] ISO 22418²⁹⁾, *Intelligent transport systems — Fast service advertisement protocol (FSAP) for general purposes in ITS*
- [42] ISO 22837, *Vehicle probe data for wide area communication*
- [43] ISO 24100, *Intelligent transport systems — Basic principles for personal data protection in probe vehicle information services*
- [44] ISO 24102-1, *Intelligent transport systems — ITS station management — Part 1: Local management*
- [45] ISO 24102-2, *Intelligent transport systems — ITS station management — Part 2: Remote management of ITS-SCUs*
- [46] ISO 24102-3, *Intelligent transport systems — ITS station management — Part 3: Service access points*
- [47] ISO 24102-4, *Intelligent transport systems — ITS station management — Part 4: Station-internal management communications*
- [48] ISO 24102-6:2018, *Intelligent Transport Systems — Communications access for land mobiles (CALM) — ITS station management — Part 6: Path and flow management*

25) Vienna Agreement cancelled by CEN; almost identical TS at CEN published with slightly different title: ISO/TS 21185:2019 *Cooperative intelligent transport systems (C-ITS) — Communication profiles*.

26) Under preparation. Stage at time of publication: ISO/PRF TR 21186-3:2021.

27) International Standard under revision with split into a multi-part document: *Intelligent transport systems — IPv6 networking —*

— *Part 1: Common terms, definitions and requirements*

— *Part 2: Addressing and forwarding*

— *Part 3: Mobility management*

— *Part 4: ITS station management adaptation entity*

28) 2nd Edition (2018) includes EN 302 663 V1.2.1.

29) Under Vienna Agreement: EN/ISO 22418:2020.

- [49] ISO 24102-7³⁰⁾, *Intelligent transport systems — ITS station management — Part 7: ITS-S capabilities*
- [50] ISO 24102-8³¹⁾, *Intelligent transport systems — ITS station management — Part 8: ITS-S application processes*
- [51] ISO 24102-9³²⁾, *Intelligent transport systems — ITS station management — Part 9: ITS-S managed entities*
- [52] ISO 24103, *Intelligent transport systems — Communications access for land mobiles (CALM) — Media adapted interface layer (MAIL)*
- [53] ISO 24978, *Intelligent transport systems — ITS Safety and emergency messages using any available wireless media — Data registry procedures*
- [54] ISO 25111, *Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks*
- [55] ISO/TS 25114, *Intelligent transport systems — Probe data reporting management (PDRM)*
- [56] ISO 29281-1, *Intelligent transport systems — Localized communications — Part 1: Fast networking & transport layer protocol (FNTP)*
- [57] ISO 29281-2, *Intelligent transport systems — Localized communications — Part 2: Legacy system support*
- [58] ISO 29282, *Intelligent transport systems — Communications access for land mobiles (CALM) — Satellite networks*
- [59] ISO/TS 29284, *Intelligent transport systems — Event-based probe vehicle data*

CEN standards

- [60] EN 16157-1, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 1: Context and framework*
- [61] EN 16157-2, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 2: Location referencing*
- [62] EN 16157-3, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 3: Situation Publication*
- [63] EN 16157-7, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 7: Common data elements*
- [64] EN 12253, *Road transport and traffic telematics - Dedicated Short Range, Communication (DSRC) — Physical layer using microwave at 5,8 GHz*
- [65] EN 12795, *Road transport and traffic telematics — Dedicated Short Range Communication (DSRC) — DSRC data link layer: medium access and logical link control*
- [66] EN 12834, *Road transport and traffic telematics — Dedicated Short Range Communication (DSRC) — DSRC application layer*
- [67] CEN/TS 17182, *Intelligent transport systems — eSafety — eCall via an ITS-station*
- [68] CEN/TS 17496³³⁾, *Cooperative intelligent transport systems (C-ITS) — Communication profiles*

30) Under preparation. Stage at time of publication: ISO/PWI 24102-7:2021.

31) Under preparation. Stage at time of publication: ISO/PWI 24102-8:2020.

32) Under preparation. Stage at time of publication: ISO/PWI 24102-9:2020.

33) Vienna Agreement cancelled by CEN; almost identical TS at ISO published with slightly different title: ISO/TS 21185 *Intelligent transport systems — Communication profiles for secure connections between trusted devices*.