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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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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].

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 14812[1)].

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.

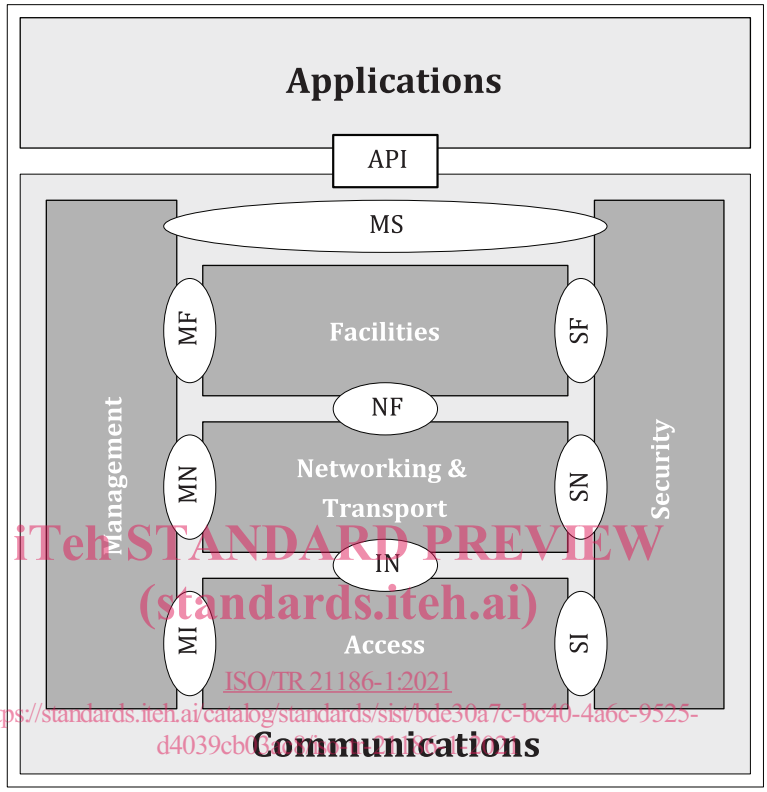

Figure 1 — Simplified ITS station architecture (ISO 21217)

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.

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;