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Intelligent transport systems — Reference model architecture(s) for the ITS sector —

Part 5: Requirements for architecture description in ITS standards

Systèmes intelligents de transport (ITS) — Architecture(s) de modèle de référence pour le secteur ITS —

Partie 5: Exigences pour la description d'architecture dans les normes ITS

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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*.

This second edition cancels and replaces the first edition (ISO 14813-5:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

— clarifies the scope of standards to which this document applies;

— clarifies and renames the types of architectures used within the ITS community and their relationships with each other;

— removes details related to planning and deployment architectures;

— clarifies requirements and provides examples of text that should be included within ITS interface standards.

A list of all parts in the ISO 14813 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

"Architecture" is implicit in any construction, be it of a physical entity (such as a building), an operational entity (such as a company or organisation), a system entity (such as a software system), or a business entity (such as a commercial business operation). While it may be stated that every entity has an architecture, that architecture may be an explicit construction as a result of a deliberate design process, or it may be the implicit result of an unplanned series of events, and sometimes the combination of both.

In the "system" domain, "architecture" can be defined as "fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution (ISO/IEC/IEEE 42010:2011, 3.2). In order for this definition to be successful there needs to be a standard way of describing the system concepts and properties.

Intelligent transport systems (ITS) are systems deployed in transportation environments to improve both the driving experience, and the safety and security of drivers, passengers and pedestrians. ITS can also assist in the labour, energy, environmental, and cost efficiency of transportation systems. It is a feature of most ITS that their architecture involves the collection, use and exchange of information/data within and between software systems which affect or control the behaviour of physical equipment in order to provide a service to the actors involved in, or interacting with, the transport sector.

ITS services are developing and changing rapidly and have to make provision not only for interaction with other services, but with migration from one technology generation to later iterations. In order to support this and to obtain compatibility and/or interoperability and to eliminate contention, the systems need to co-exist and operate within a known and supportive architectural framework. This document is designed to aid these objectives and to enable maximum interoperability, efficiency, and migration capability by defining an explicit process for describing ITS reference architectures for use within ITS International Standards using an explicit process.

The word “architecture” has been used in an informal manner to mean a variety of different concepts, and in formal architecture design there are differing methodologies and opinions as to their suitability for use in ITS itself and standards design. This has limited the effective communication in the ITS sector by causing uncertainty as to the meaning of the word “architecture” when it is used. A second function of this document is to provide consistent terminology to be used in describing architectural aspects of ITS standards and provide a consistent form for describing an ITS reference architecture in standards in the ITS sector.

This document does not give preference to any one methodology for architecture development and description, it assumes that the consideration of architecture is an explicit process that takes into account the interrelationships and interoperability of ITS and that an architecture description is provided within ITS standards. It also assumes that the architecture aspects of ITS standards are described explicitly in each and every ITS standard and that all standards are related to one or more ITS service(s) that they are designed to enable or support.

Intelligent transport systems — Reference model architecture(s) for the ITS sector —

Part 5: Requirements for architecture description in ITS standards

1 Scope

An intelligent transport system (ITS) reference architecture is a tool that describes how an ITS delivers one or more ITS services. It includes a high-level description of the major elements and the interconnections among them that are needed for the service(s) to be provided to stakeholders. It provides the framework around which the interfaces, specifications, and detailed ITS designs can be standardized within ITS standards.

By contrast, ITS standards are often focused on design details. While the development of these standards may be initiated by a single ITS user need, they are often (and properly) written in a generic format that allows for application in a broad array of contexts. However, this can present a challenge to the reader in understanding the original purpose of a standard and whether the standard is intended for other environments.

This document defines documentation rules for standards that define interfaces between or among system elements of an ITS reference architecture. This includes:

a) requirements for documenting aspects of the ITS reference architecture;

b) terminology to be used when documenting or referencing aspects of the ITS reference architecture.

In compiling this document, the authors have assumed that contemporary systems engineering practices are used. Such practices are not defined within this document.

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

ISO/IEC 9834-1, *Information technology — Procedures for the operation of object identifier registration authorities: General procedures and top arcs of the international object identifier tree — Part 1*

ISO/IEC 11179-3, *Information technology — Metadata registries (MDR) — Part 3: Registry metamodel and basic attributes*

ISO/IEC 19501, *Information technology — Open Distributed Processing — Unified Modeling Language (UML) Version 1.4.2*

ISO/IEC/IEEE 42010:2011, *Systems and software engineering — Architecture description*

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 https://www.iso.org/obp

3.1
architecture
<system> fundamental concepts or properties of a system in its environment embodied in its *elements* (3.10), relationships, and in the principles of its design and evolution

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.2]

3.2
architecture description
AD
work product used to express an *architecture* (3.1)

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.3]

3.3
architecture model
work product representing one or more *architecture views* (3.4) and expressed in a format governed by a *model kind* (3.18)

3.4
architecture view
work product expressing the *architecture* (3.1) of a system from the perspective of specific system *concerns* (3.8)

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.5]

3.5
architecture viewpoint
work product establishing the conventions for the construction, interpretation and use of *architecture views* (3.4) to frame specific system *concerns* (3.8)

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.6]

3.6
communications view
architecture view (3.4) from the *communications viewpoint* (3.7)

3.7
communications viewpoint
architecture viewpoint (3.5) used to frame communication interface concerns, including all layers of the OSI stack and related management and security issues

3.8
concern
<system> interest in a system relevant to one or more of its *stakeholders* (3.25)

Note 1 to entry: A concern pertains to any influence on a system in its environment, including developmental, technological, business, operational, organizational, political, economic, legal, regulatory, ecological and social influences.

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.7]

3.9
deployment architecture
project architecture
low-level architecture
design-level architecture
architecture (3.1) that provides a vision of a specific deployment of a system within a geographic area

Note 1 to entry: Experts use a variety of terms to describe this concept; ISO/TC 204 prefers the term “deployment architecture”.

3.10
element
<system> component member of an *architecture* (3.1)

3.11
functional view
architecture view (3.4) from the *functional viewpoint* (3.12)

3.12
functional viewpoint
architecture viewpoint (3.5) used to frame the functionality concerns, including the definition of processes that perform transport functions and data flows shared between these processes

3.13
information exchange
information flow (3.14) from a *physical object* (3.19) acting as an information source and sent to another physical object acting as an information sink

3.14
information flow
information that is exchanged between *physical objects* (3.19)

3.15
intelligent transport system
ITS
technology system that is designed to benefit a surface transport system

3.16
interface
<system> boundary between two elements of a system or between two systems

3.17
ITS reference architecture
reference architecture (3.23) for one or more ITS *services* (3.24)

3.18
model kind
conventions for a type of modelling

Note 1 to entry: Examples of model kinds include data flow diagrams, class diagrams, Petri nets, balance sheets, organization charts and state transition models.

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.9]

3.19
physical object
element (3.10) within the *physical view* (3.20) of an *ITS reference architecture* (3.17) that represents a physical entity that interacts with other physical entities in the provision of ITS *services* (3.24)

3.20
physical view
architecture view (3.4) from the *physical viewpoint* (3.21)

3.21
physical viewpoint
architecture viewpoint (3.5) used to frame system engineering concerns

Note 1 to entry: System engineering concerns include the definitions of physical entities, the assignment of functionality to physical entities, the interfaces among these physical entities, and security and privacy concerns related to those entities and their interfaces.

3.22
planning architecture
regional architecture
high-level architecture
architecture (3.1) that provides a long-term vision of system *elements* (3.10) that may be deployed and managed by different projects and/or entities within a geographic area

Note 1 to entry: The term “regional architecture” is widely used within the US, but “regional” becomes rather ambiguous when applied to international standards. The term “high-level architecture” is also sometimes used, but the ISO/TC 204 preferred term is “planning architecture”.

3.23
reference architecture
template solution for an *architecture* (3.1) for a particular domain

Note 1 to entry: A reference architecture, as used to develop standards and generic rules, is not specific to any single location while planning and deployment architectures are typically specific to a location.

3.24
service
<ITS> performance of one or more tasks that fulfils an *ITS user need* (3.26) for an ITS user

3.25
stakeholder
<system> individual, team, organization, or classes thereof, having an interest in a system

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.10]

3.26
user need
<ITS> need of an entity external to the *intelligent transport system* (3.15) for a surface transport system benefit that can be met with the use of a technology system

4 Symbols and abbreviated terms

ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
CEN	European Committee for Standardization
CIDCR	Central ITS Data Concept Registry
CVRIA	Connected Vehicle Reference Implementation Architecture
FRAME	European ITS Framework Architecture
HARTS	Harmonised Architecture Reference for Technical Standards
ITS	Intelligent Transport System

5 Conformance

There are no specific conformance tests specified within or associated with this document.

Developers of International Standards are, however, required to describe the reference architecture of the system to which their deliverable relates or to reference other International Standards or publicly available documents that provide such a description.

NOTE While this document is intended to define requirements for documenting reference architectures within standards, much of the content can also assist implementers of ITS in their documentation of planning architectures and deployment architectures.

6 Background and general information

6.1 General

Architectures have been used as a part of the ITS implementation process for over 20 years. They provide stakeholders with a clear understanding of how ITS services are to be delivered so that informed decisions can be made as early as possible in the ITS implementation process. While the content, format, viewpoints, and other details of architectures have evolved over time to better meet industry needs; this section provides an overview of the current best practices.

6.2 Levels of abstraction

Within the ITS industry, architectures are often presented in three distinct levels of abstraction as depicted in Figure 1.

Reference architectures reflect the requirements set forth by the industry-wide stakeholder community. These architectures provide a relatively generic template that characterizes how ITS elements typically interact with one another to provide services that are widely deployed. At this level of abstraction, system elements are entirely conceptual – they describe types of elements that might be deployed. Because a reference architecture represents typical deployments, it is useful for identifying interfaces between system elements that can be standardized.

Planning architectures are intended to address stakeholder concerns in developing a long-term vision (e.g. 5 to 20 years) of ITS deployments within a geographic area at a level that facilitates project planning. At this level of abstraction, the architecture identifies the specific system elements to be deployed and identifies which elements and ITS services are existing, if any, and which are merely planned. Ideally, the planning architecture should be used as the primary source for the deployment plans (e.g. timeframe) for each planned system element. Planning architectures should generally be derived from a reference architecture in order to benefit from the previous work and standardization, but the derivation process will typically omit some ITS services that are not envisioned for the region while perhaps also adding new ITS services that are specific to the region.

Deployment architectures are intended to address local stakeholder concerns related to a specific deployment project. At this level of abstraction, the architecture must identify the system elements that will be separately procured and identify how these system elements will interface with one another (ideally using some set of the standards created in response to the associated reference architecture). Deployment architectures should generally be derived from a planning architecture to provide consistency with the long-term vision but will generally only depict the subset of the planning architecture that is to be deployed as a part of the project.