
**Transport information and control
systems — Reference model architecture(s)
for the TICS sector —**

Part 5:

Requirements for architecture description
in TICS standards

*Systèmes de commande et d'information des transports — Architecture(s)
de modèle de référence pour le secteur TICS —*

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



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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 main task of technical committees is to prepare International Standards, but in exceptional circumstances, a technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 14813-5, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 204, *Transport information and control systems*.

It is intended that all standards developed for the Road Traffic and Transport Telematics (RTTT)/Transport Information and Control System (TICS) sector conform to these interpretations of definitions and that all standards for the TICS sector follow the prescribed format in documenting system architecture aspects of their standards.

ISO/TR 14813 consists of the following parts, under the general title *Transport information and control systems — Reference model architecture(s) for the TICS sector*:

- *Part 1: TICS fundamental services*
- *Part 2: Core reference model*
- *Part 3: Example elaboration*
- *Part 4: Reference model tutorial*
- *Part 5: Requirements for architecture description in TICS standards*
- *Part 6: Data presentation in ASN.1*
- *Part 7: TICS data profiles*

Annex A of this part of ISO/TR 14813 is for information only.

Introduction

The word “Architecture” has been used in an informal manner to mean a variety of different concepts. This has limited the effective communication in the TICS sector by causing uncertainty as to the meaning of the word “Architecture” when it is used. The purpose of this part of ISO/TR 14813 is to specify the terminology to be used in describing architectural aspects of TICS standards, and provide a consistent form for TICS architecture description in standards in the TICS sector.

In order to maximise the efficiency of co-existing TICS systems, and in order 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.

In order for such a supportive architectural framework to be developed and for compatibility and interoperability to be obtained, it is a pre-requisite both to apply the same definition of terminology used, and to describe the requirements for architecture description in TICS standards in a consistent manner.

This part of ISO/TR 14813 requires that the architecture aspects of TICS standards are described explicitly in each and every TICS standard and that all standards are related to the (one or more) TICS Fundamental Service(s) that they are designed to enable or support.

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Transport information and control systems — Reference model architecture(s) for the TICS sector —

Part 5:

Requirements for architecture description in TICS standards

1 Scope

A TICS architecture is a framework for TICS deployments. It is a high level description of the major elements and the interconnections among them. It provides the framework around which the interfaces, specifications and detailed TICS systems designs can be defined. A TICS Architecture is not a product design, nor a detailed specification for physical deployment, and it is not specific to any one location. The title 'Systems Architecture' is perhaps the closest general terminology, but that term is sometimes too specific to include the conceptual aspects included in the terminology 'TICS Architecture' and also often implies a location specific solution.

The purpose of a TICS Architecture is to maximise efficiency, interoperability and multimodality of multiple interacting TICS systems in a complex and developing sector.

This part of ISO/TR 14813 defines

- a) Terminology to be used when documenting or referencing aspects of architecture description in TICS standards.
- b) The form in which aspects of System Architecture are to be documented and described in TICS standards.

In compiling this part of ISO/TR 14813, the authors have assumed that contemporary systems engineering practices are used. Such practices are not defined within this part of ISO/TR 14813.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/TR 14813. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/TR 14813 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/TR 14813-1, *Transport information and control systems — Reference model architecture(s) for the TICS sector — Part 1: TICS fundamental services.*

ISO/TR 14813-6, *Transport information and control systems — Reference model architecture(s) for the TICS sector — Part 6: Data presentation in ASN.1.*

ISO/IEC 8824-1:1995, *Information technology — Abstract Syntax Notation (ASN.1): Specification of basic notation.*

ISO/IEC 8824-1:1995/Amd.1:1996, *Information technology — Abstract Syntax Notation (ASN.1): Specification of basic notation, Amendment 1: Rules of extensibility.*

ISO/IEC 8824-2:1995, *Information technology — Abstract Syntax Notation (ASN.1): Information object specification.*

ISO/IEC 8824-2:1995/Amd.1:1996, *Information technology — Abstract Syntax Notation (ASN.1): Information object specification, Amendment 1: Rules of extensibility.*

ISO/IEC 8824-3:1995, *Information technology — Abstract Syntax Notation (ASN.1): Constraint specification.*

ISO/IEC 8824-4:1995, *Information technology — Abstract Syntax Notation (ASN.1): Parameterization of ASN.1 specifications.*

ISO/IEC 8825-1:1995, *Information technology — ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*

ISO/IEC 8825-2:1996, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER).*

3 Terms and definitions

For the purposes of this part of ISO/TR 14813, the following terms and definitions apply.

3.1 Glossary of Terms

This Glossary of Terms shall be used in TICS standards where architectures are described or TICS architecture aspects are referred to.

3.1.1

Application Architecture

a set of functions combined to form a high level system design

3.1.2

Architecture Element

a definable element of a system, which forms part of a component or system, but does not necessarily have independent operational functionality

3.1.3

ASN.1

Abstract Syntax Notation Number One, as defined in ISO/IEC 8824

3.1.4

Basic Encoding Rules

a standardised determination of data encoding to conform to the requirements of ISO/IEC 8824 ASN.1 (Abstract Syntax Notation One)

NOTE The Basic Encoding Rules (BER) are defined in ISO/IEC 8825. Note that there are alternate forms of encodation such as Packed Encoding Rules (PER) (*see Packed Encoding Rules*).

3.1.5

Class

a class is a descriptor of a set of objects with similar structure, behaviour and relationships

3.1.6

Compatibility

the ability of any (sub)system to interact with another (sub)system according to a set of predefined rules in the form of interface specification and protocol definition

3.1.7

Conceptual Architecture

an overall description of a system incorporating operational concepts and user requirements, together with its known inter-relationships with other systems

NOTE Normally expressed/supported by means of vision/mission statements, a simple hierarchy chart or network diagram (e.g. reference model) dealing with only the overall concepts and relationships and reference points. A Conceptual Architecture is not specific to any location.

3.1.8

Control Architecture

describes the control behaviour of TICS Architecture elements to effect change from one state (condition) to another (state transition management)

NOTE A Control Architecture is not specific to any location.

3.1.9

Data Construct

a group of one or more data elements (primitive or constructed as defined in ISO 8825) used to represent state or information

3.1.10

Deployment Design

Implementation Design

the specific design for a deployment describes the actual equipment to achieve the application architecture

NOTE *The Deployment Design is not considered appropriate for Standardisation.* The Deployment (Implementation) Design is sometimes incorrectly referred to as a 'Physical Architecture'. However, the Deployment (Application) Design is specific in location and often also in time, whereas a TICS Architecture is not.

3.1.11

Deployment of TICS

the actual TICS equipment, software, facilities, devices etc. at a specific location and at a specific time

3.1.12

Design

the way that parts or constituents are related to an organised whole (Webster)

3.1.13

Electronic Data Interchange (EDI)

the passing of a data message, or series of messages, between computers and/or between different software systems (e.g. EDIFACT)

3.1.14

Electronic Data Transfer (EDT)

the passing of data sets comprising an entire message from one computer to another or from one software system to another

3.1.15

Functional Architecture

a Functional Architecture is an aspect of a 'Logical', 'Process Oriented' decomposition of an overall TICS Architecture (see *Process Oriented Logical Architecture*)

NOTE A Functional Architecture is not specific to any location.

3.1.16

Information Architecture

with respect to process oriented decomposition, the Information Architecture defines the entities and the relationships of information (Data model) and the principal data constructs (see *Process Oriented and Logical Architecture*)

NOTE The Information Architecture is not specific to any location.

3.1.17**Institutional Architecture**

an architecture based on political or administrative infrastructure partitioning and its division of responsibilities (rather than functions)

3.1.18**Implementation Design**

see Deployment Design

3.1.19**Interoperability**

the ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together

3.1.20**Logical Architecture**

a logical architecture can be described either from an Object Oriented, or Process Oriented, perspective (see *Object Oriented* and *Process Oriented*)

NOTE In an object oriented perspective a logical architecture elaborates the conceptual behaviour and in so doing defines some detail of the objects.

In a process oriented perspective, logical architecture determines the nature of the system as being based on information and functions, and describes the inter-relationships of these aspects.

The logical architecture is independent of any hardware or software approach.

3.1.21**Maintainability**

ability of a device to be maintained at or restored to specified conditions within a given period of time

3.1.22**Message**

a set of data grouped together for transmission

3.1.23**Methodology**

a specific set of means or procedures used in attaining an end

3.1.24**Mission Statement**

a statement of what objective results are to be provided by the standard and how it is intended to achieve the vision (see *Vision Statement*)

3.1.25**Non Specified Design**

a design in generic terms based on a requirement rather than an exact identification of equipment specification or manufacturer's identification

3.1.26**Object**

an object is an instance of a class (e.g. a vehicle, a beacon, etc.)

3.1.27**Object Oriented Methodology**

a methodology based on *objects*, *classes* and *messages* between objects

3.1.28**OSI Model**

the International Organization for Standardization has developed a reference model, the Open Systems Interconnection (OSI) model, to enable different or similar systems to dialogue with one another

NOTE This model constitutes a reference framework for describing data exchanges. It is described in 7 'layers'.

3.1.29

Packed Encoding Rules

a determination of data encoding to conform to the requirements of 8824 ASN.1 (Abstract Syntax Notation One)

NOTE The Packed Encoding rules are defined in ISO/IEC 8825-2. Note that this is one specific method of encodation. There are alternate forms of encodation such as Basic Encoding Rules (BER) (see *Basic Encoding Rules*).

3.1.30

Physical (Application) Architecture

the allocation of the logical architecture to physical entities but not relating to the deployment of equipment

NOTE A Physical Architecture, whilst describing physical configurations in system terms, is not specific to any particular location.

3.1.31

Process Oriented Methodology

a methodology based on decomposition of the conceptual architecture into functional, control and information Architectures

3.1.32

Reference Point

an identifier for a component of an architecture which indicates the component shall be elaborated in a subsequent architecture

3.1.33

Reliability

ability of a device to perform its intended function under given conditions of use for a specified period of time (or number of cycles)

3.1.34

Specified Design

the exact equipment specification or manufacturer's identification as installed in a deployment

3.1.35

TICS Architecture

the non specified system design for a family of functionally different systems, interconnected to operate in harmony

NOTE A TICS Architecture can be described by conceptual, logical and/or physical representations. (See also *Conceptual Architecture, Functional Architecture, Logical Architecture, Deployment Design*.) A TICS Architecture is not specific to any single location.

3.1.36

TICS Component

a subsystem of a TICS system, assembly, or other major element of a system which does not have, by itself, independent operational functionality

3.1.37

TICS Fundamental Service

a TICS fundamental service is an informational product or service or applications area provided to a TICS user

3.1.38

TICS System

a set of inter-related components which interact with one another in an organised fashion to provide independent operational functionality

NOTE This is the IEEE Definition of a system qualified with the "Independent operational functionality" phase.

3.1.39**TICS Unit**

minimum component capable of independent functionality

3.1.40**User**

the prime beneficiary of the TICS system. A user may be an end user (e.g. vehicle operator) or a system provider (e.g. traffic system manager) or other intermediary who uses the system

3.1.41**Vision Statement**

a statement summarising the overall concept and goals that the standard seeks to achieve

3.2 Glossary of Abbreviations

This Glossary of Abbreviations shall be used in describing TICS architecture aspects of TICS standards.

BER Basic Encoding Rules (of ISO/IEC 8825, re ASN.1)

IEEE Institute of Electrical and Electronics Engineers

PER Packed Encoding Rules (re ASN.1)

RTTT Road Transport and Traffic Telematics

TICS Transport Information and Control System

TC Technical Committee

WG Working Group

3.2.1 Numerical Notations

For the purposes of this part of ISO/TR 14813, and for CEN and ISO standards in the TICS sector, the following conventions apply. Numerical notations are represented as follows:

Decimal ("normal") notation shall have no subscript, e.g.: 127

Hexadecimal numbers shall be noted by subscript 16, e.g.: 7F₁₆

Binary numbers shall be noted by subscript 2, e.g.: 01111111₂

4 Requirements**4.1 General Requirements**

4.1.1 TICS standards shall provide an 'Architecture' description, by inclusion in the standard or by reference to other relevant standards. The architecture description shall include information detailing the vision and mission to be achieved by applying the standard, together with a description of the architectural aspects of the standard, detailed in one of the forms described in this part of ISO/TR 14813. Such information may appear in either the Scope or Requirements clauses as considered appropriate by the authors.

4.1.2 All architecture descriptions shall either start with, or be clearly related to, one or more of the TICS Fundamental Services (ISO/TR 14813-1).

4.1.3 It is important that all TICS standards can be compared for inter-relationships and therefore it is a requirement that the following methodology is applied for the architecture description elements of all TICS standards.

- a) TICS SYSTEM DESCRIPTIONS/DEFINITION Where schematics are included, they shall be expressed in the form of process or object models.
- b) PROTOCOL DESCRIPTIONS/DEFINITION In most cases, protocol descriptions, will not be required in an Architecture Standard. If protocol descriptions are required, they shall be written in a widely accepted and standardised formal description language. (For example SDL.)
- c) DATA DESCRIPTION/DEFINITION Data constructs, where included, shall conform to, and shall be described according to ASN.1 as determined in ISO/TR 14813-6, Data Presentation in ASN.1, ISO/IEC 8824 and ISO/IEC 8825. Within TICS standards, reference to ASN.1 shall also imply the use of Packed Encoding Rules (aligned) as specified in ISO/IEC 8825 unless otherwise stated.

Where a sector already uses an existing standard notation (e.g. EDIFACT, X12), such use is permissible so long as the message content, structure and the transaction elements are clearly and separably defined. Usually this will be by reference to another standard (e.g. EDIFACT BOARD Standard). Where attribute limitations (e.g. range of numerical values) are appropriate within the TICS standard (e.g. where a time/size limited an interface transaction is involved) such attribute limitations shall be specified.

Where there is no extant standardised public domain notation already in commercial use, ASN.1 shall always be used.

4.2 TICS Architecture Elements

A TICS Architecture is "The non specified system design for a family of functionally different TICS systems, interconnected to operate in consort".

All TICS standards shall provide a description of aspects of their Architecture, either by Process Oriented or Object Oriented analysis, although the depth of such description shall vary according to the relevance to the standard. Where a limited standard (e.g. one determining protocols alone) is prepared, a simple statement determining its relevance in the overall architecture shall suffice. The following clauses describe the documentation requirements for each of these Architecture aspects.

A TICS Architecture shall be described at three levels:

- a) Conceptual Architecture (starting from, and related to, one specific TICS Fundamental Service).
- b) Logical Architecture.
- c) Physical Architecture.

4.2.1 Conceptual Architecture

4.2.1.1 This subclause shall provide an overall operational description of a TICS system incorporating operational concepts and user requirements, together with its known inter-relationships with other systems. The description of the Conceptual Architecture shall always use one or more of the TICS Fundamental Services as its starting point, or its scope be related clearly to assisting the fulfilment of one or more specified TICS Fundamental Services.

4.2.1.2 This overview shall be described by means of **vision/mission statements describing the objective result of applying the standard** and the method by which they are to be achieved shall be explained.

4.2.1.3 This shall usually be accompanied by a simple hierarchy chart or network diagram (e.g. reference model) dealing with only the overall system concepts and relationships and reference points.

4.2.2 Logical Architecture

The logical architecture shall be independent of any implementation.

A logical architecture can be described either from an Object Oriented, or Process Oriented, perspective. Either methodology may be used at the discretion of the working group preparing the standard.

4.2.2.1 Object Oriented

4.2.2.1.1 If an Object Oriented approach is used to describe the logical architecture it shall provide an integrated description working from the identified classes, their attributes, methods and messages and associations. In order to achieve consistency of approach and to enable cross-referencing between standards, The Object Analysis symbols used shall be from the Unified Modelling Language (UML), and shall, as far as practicable, use the UML Views of the model that are deemed to be appropriate. There is no requirement that all possible UML Views shall always be used.

4.2.2.1.2 In an object oriented analysis of the architectural aspects of a TICS standard, the highest level (abstract) 'Classes' described shall always be related to the provision of one or more specified TICS Fundamental Services.

4.2.2.1.3 Architecture (where appropriate)

This shall provide a description of the control behaviour of TICS Architecture elements to effect change from one state (condition) to another (state transition management).

4.2.2.2 Process Oriented

A Process Oriented (functional) decomposition of the Logical Architecture is represented by Functional, Control and Information Architectures. If a Process Oriented approach is used in the standard, these representations of the Functional Architecture shall be described as:

4.2.2.2.1 Functional Architecture

This shall provide a description or definition in terms of processes and data flows. It shall not include hardware or physical items.

4.2.2.2.2 Control Architecture (where appropriate)

This shall provide a description of the control behaviour of TICS Architecture elements to effect change from one state (condition) to another (state transition management).

4.2.2.2.3 Information Architecture

The Information Architecture shall define the conceptual structure of the information and its meaning and, where appropriate, the principal data constructs.

4.2.3 Physical Architecture

The Physical Architecture shall describe the physical configuration and physical interconnection of equipment, to achieve its performance (but not the deployment equipment itself).

4.3 Application Architecture/Deployment (Implementation) Design

The specific design for a deployment describes the actual equipment deployment, in one or more specific locations, designed to achieve the application architectures. The Deployment Architecture is not considered appropriate for standardisation and shall not be included in a TICS standard. Where considered useful to assist understanding of the standard, an informative annex may show an example of a deployment design that uses the architecture defined in the standard.

4.4 Layout of Architecture Descriptions in TICS Standards

4.4.1 So long as the definition and description requirements are met in explicit clauses of every TICS standard, authors of TICS standards shall have freedom to describe the aspects of their system architecture in the manner that best describes their architecture to the lay person.