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Transport information and control systems — Requirements for an ITS/TICS central Data Registry and ITS/TICS Data Dictionaries

Systèmes d'information et de commande des transports — Exigences pour un registre de données central ITS/TICS et pour les dictionnaires de données ITS/TICS

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

Foreword v

Introduction vi
0.1 Background vi
0.2 Document overview vii

1 Scope 1

2 Conformance 1
2.1 Conformance considerations 1
2.2 Strictly conforming implementations 2
2.3 Conforming implementations 2

3 Normative references 2

4 Terms and definitions 2

5 Symbols and abbreviated terms 5

6 Concept of operation 6
6.1 Summary 6
6.2 Framework 7
6.3 Organizational roles 8
6.4 Registration status levels 10
6.5 Procedures 11
6.6 Version control 12

7 Data concepts 12
7.1 Summary of data concepts 12
7.2 Interface dialogue 14
7.3 Message 14
7.4 Data frame 14
7.5 Object class 14
7.6 Association 14
7.7 Property 15
7.8 Data element concept 15
7.9 Value domain 15
7.10 Data element 15

8 Data concept meta attributes 15
8.1 Basic meta attributes of data concepts 15
8.2 Administrative meta attributes 17

9 Data concept names 18
9.1 Descriptive names 18
9.2 Data concept descriptive name formats 18

10 Meta attribute requirements for ITS/TICS data concepts 19

11 International relationships 19

Annex A (informative) **ITS/TICS functional operating procedures** 21

Annex B (normative) **Contents of the ITS/TICS Data Registry and ITS/TICS Data Dictionaries: Meta attribute definitions** 37

Annex C (normative) **Contents of the ITS/TICS Data Registry and ITS/TICS Data Dictionaries: Meta attribute requirements for data concepts** 51

Annex D (normative) **Data concept names** **60**
Annex E (informative) **Data representation in an information model** **66**
Annex F (informative) **ASN.1 information object specification for an ITS/TICS data concept** **75**
Bibliography **91**

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14817 was prepared by Technical Committee ISO/TC 204, *Transport information and control systems*.

Introduction

0.1 Background

This International Standard has been developed by ISO/TC 204/WG 1, *Architecture*, in order to provide a framework for the documentation and registration of data that passes through system interfaces within the Intelligent Transport System / Transport Information and Control Systems (ITS/TICS) domain.

The International Standard is designed to maximize interoperability and facilitate information reuse.

This International Standard defines the registration process for ITS/TICS. It further defines the Data Dictionary and the Data Registry content and Data Registry management procedures.

Vision statement

> This International Standard envisions common use and maximum interoperability of data within the ITS/TICS sector by the creation and maintenance of an ITS/TICS Data Registry, supported by interface and application specific ITS/TICS Data Dictionaries, created and maintained in a common and interoperable form, and to ensure the minimization of duplication by clear rules for data concept definition and Data Registry management.

Mission statement

> The mission is to develop a standard to define the principles and concepts; scope; field of application; rules and procedures; definition and concept of operation for a central ITS/TICS Data Registry and ITS/TICS functional Data Dictionaries; and to make provision for the migration of data from ITS/TICS functional Data Dictionaries to the central Registry so as to maximize interoperability and minimize proliferation of similar (but inconsistently defined) data entries.

This International Standard defines the framework, formats, and procedures used to define information and information exchanges within the ITS/TICS sector. The standard is designed to be used by the ITS/TICS community at large, but should be of special interest to application developers, equipment providers, and Data Registry managers.

This International Standard specifies a set of meta attributes for ITS/TICS Data Dictionaries, as well as associated conventions and schemes, that enables the description, standardization and management of all exchanged ITS/TICS data. Through consistent use of these common structures and associated conventions and schemes, interchange of data and information among the various ITS/TICS functional subsystems via their specific application systems can be maximized. This International Standard also supports reuse of data elements and other data concepts across various ITS/TICS functional subsystems and their specific application systems.

The Data Registry process defined within this International Standard is consistent with implementation(s) of the ISO ITS/TICS System Architecture defined in the ISO 14813 Standardization deliverables, particularly ISO 14813 Parts 2 and 3. This does not preclude the application of the Data Registry using alternative International, Regional or National System Architecture methodologies or techniques, indeed, a common Data Registry will ease migration and interoperability between such approaches.

The ITS/TICS data concepts that populate the ITS/TICS Data Registry may originate from a Computer-Aided Software Engineering (CASE) tool implementation of the ISO 14813 TICS Reference Architecture, from International Standards for ITS, from National implementations for ITS, or from the submission by relevant users. Data Dictionary entries are not limited to those generated by object oriented methodologies.

0.2 Document overview

This clause provides an overview of this International Standard. Clause 1 identifies the scope of this International Standard. Clause 2 identifies requirements for conformance to this International Standard. Clause 3 identifies references required for proper implementation of this International Standard. Clause 4 defines terms used in this International Standard and Clause 5 lists the abbreviations.

The requirements for the ITS/TICS central Data Registry and ITS/TICS Data Dictionaries begin in Clause 6 with an overview of the concept of operations for the ITS/TICS Data Registry and ITS/TICS Data Dictionaries. A framework describing the registration of different types of data concepts in the ITS/TICS Data Registry and the registration status levels are presented.

Clause 7 identifies the fundamental ITS/TICS data concepts while Clause 8 identifies the basic and administrative meta attributes used to document them. Clause 9 describes the naming conventions and name abbreviation conventions used. Clause 10 states the requirements for the data concepts and the meta attributes contained in the ITS/TICS Data Registry and ITS/TICS Data Dictionaries.

Clause 11 provides a reference model for national, regional and international relationships and summarizes internationalization aspects associated with national and regional requirements for the ITS/TICS Data Registry and Data Dictionary environment.

The annexes to this International Standard describe the specific details for implementing the requirements introduced in Clauses 6 through 11. Annex A details ITS/TICS functional operating procedures for registration and harmonization of data concepts. Annex B prescribes the detailed definitions and descriptions of the ITS/TICS Data Registry and Data Dictionary meta attributes. Annex C prescribes the meta attribute requirements for data concepts contained in the ITS/TICS Data Registry and ITS/TICS Data Dictionaries. Annex D specifies the naming and name abbreviation conventions and the process for converting ITS/TICS descriptive names to ASN.1 names. Annex E contains the rules for data representation in an information model, along with examples. Annex F describes the ASN.1 information object specification for an ITS/TICS data concept with examples.

The bibliography includes a list of documents related to this International Standard.

Transport information and control systems — Requirements for an ITS/TICS central Data Registry and ITS/TICS Data Dictionaries

1 Scope

This International Standard specifies the framework, formats, and procedures used to define information exchanges within the Intelligent Transport System/Transport Information and Control Systems (ITS/TICS) sector. It defines the content of the ITS/TICS central Data Registry and Data Dictionaries, the registration process to enter data concepts into the Data Registry. Throughout the text, the Data Registry should be taken to mean the ITS/TICS central Data Registry.

Specifically, this International Standard specifies:

— framework used to identify and define all information exchanges;

— framework used to extend standardized information exchanges to support local customizations and combinations;

— information modelling method for defining ITS/TICS data concepts, when used;

— meta attributes used to describe, standardize and manage each of the data concepts defined within this framework;

— requirements used to record these definitions; and

— formal procedures used to register these definitions within the Data Registry.

The Data Registry described herein supports, and is designed to include, data concepts using alternative International, Regional or National System Architecture methodologies or techniques. A common Data Registry will ease migration and interoperability between such approaches.

2 Conformance

2.1 Conformance considerations

This International Standard prescribes a conceptual model, but not a physical implementation. Therefore, the meta model need not be physically implemented exactly as specified. However, it should be possible to map unambiguously to and from the implementation and the meta model.

Regional and National Data Registries/Dictionaries have the option of adopting data concept definitions from the ITS/TICS Data Registry/Dictionaries, but are not required to do so. However, in the case of exchanging information internationally in application programs, claiming conformance with this or other international Standards in ITS/TICS sector, it ***is*** a requirement to use only data concepts that have already been registered in the ITS/TICS Data Registry.

2.2 Strictly conforming implementations

A strictly conforming implementation shall be a strictly conforming metadata set.

A strictly conforming implementation:

a) shall support all mandatory, optional and conditional data concept attributes (see Annex C);

b) shall not use, test, access, or probe for any extensions to data concept attributes;

c) shall not exceed limits nor minimum-maximum values specified by this International Standard; and

d) shall not interpret nor allow the production of data concept attributes that are dependent on any unspecified, undefined, or implementation-defined behaviour.

2.3 Conforming implementations

A conforming implementation shall be a conforming metadata set.

A conforming implementation:

a) shall support all mandatory, optional and conditional data concept attributes (see Annex C);

b) as permitted by the implementation, may exceed use, test, access, or probe for extensions to data concept attributes;

c) as permitted by the implementation, may exceed limits or minimum-maximum values specified by this International Standard; and

d) may interpret or allow the production of data concept attributes that are dependent on implementation-defined behaviour.

3 Normative references

The following referenced documents are indispensable for the application 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 8824-1:1998, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC 8824-2:1998, *Information technology — Abstract Syntax Notation One (ASN.1): Information object specification*

ISO/IEC 9834-1:1993, *Information technology — Open Systems Interconnection — Procedures for the operation of OSI Registration Authorities: General procedures*

ISO 1000:1992, *SI Units and recommendations for use of their multiples and of certain other units*

ISO/IEC Directives, Part 1, 4th Edition, 2001

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE Definitions of Data Registry and Data Dictionary meta attributes are given in Annex B.

4.1
association
data concept; structural relationship

4.2
classification scheme
scheme for the arrangement or division of objects into groups by functional area

4.3
data
representations of static or dynamic objects in a formalized manner suitable for communication, interpretation, or processing by humans or by machines

4.4
data concept
any of a group of Data Dictionary structures defined in this International Standard (i.e. object class, property, value domain, data element concept, data element, data frame, message, interface dialogue, association) referring to abstractions or things in the natural world that can be identified with explicit boundaries and meaning and whose properties and behaviour all follow the same rules

4.5
data concept instance
individual occurrence of a data concept

4.6
Data Dictionary
DD
organized and constructed (electronic data base) compilation of descriptions of data concepts that provides a consistent means for documenting, storing and retrieving the syntactical form (i.e. representational form) and the meaning and connotation of each data concept

4.7
data element
data concept; some single unit of information of interest (such as a fact, proposition, observation, etc.) about some (entity) class of interest (e.g. a person, place, process, property, concept, association, state, event) considered to be indivisible in a particular context

NOTE A data element is represented by an object class, a property of the represented object class and a value domain.

4.8
data element concept
data concept; an expression of the inherent concept embodied in a data element without regard to the value domain(s) by which it can be physically represented

NOTE A data element concept is represented by an object class and a property of that object class.

4.9
data frame
data concept; grouping of data elements primarily for the purpose of referring to the group with a single name, and thereby efficiently reusing groups of data elements that commonly appear together (e.g. ASN.1 SEQUENCE, SEQUENCE OF, SET, SET OF or CHOICE) in a message specification

NOTE This data concept type may be used to specify groups of data elements for other purposes as well.

4.10
data model
description of the organization of data in a manner that reflects an information structure

NOTE See also information model.

4.11
Data Registry
DR
store of data, characterized in a consistent manner, as determined according to the provisions of this International Standard, used for a specific purpose (in this case ITS/TICS)

NOTE The data registration process provides a determination of the ITS Data Dictionary items accepted into the ITS/TICS Data Registry. The Data Registry contains not only data about data concepts in terms of their names and representational forms but also substantial data about the semantics or meaning associated with the data concepts. A Data Registry may contain data that assists information interchange and reuse, both from the perspective of human users and for machine-interpretation of data concepts. The Data Registry is comprised of items only from ITS/TICS Data Dictionaries, showing their source; however, not all ITS/TICS Data Dictionary items shall necessarily be submitted for inclusion, or accepted, into the Data Registry.

4.12
data registrar
organizational element or an individual appointed by ISO/TC 204 to undertake the day-to-day management of the Data Registry process

4.13
data registration process
process by which data is formally described and provided to an approved location in the Data Registry

NOTE This process is effected under the control of the ITS/TICS data registrar, in accordance with the requirements of this International Standard.

4.14
data type
classification of the collection of letters, digits, and/or symbols used to encode values of a data element based upon the operations that can be performed on the data element

4.15
identifier
means of designating or referring to a specific data concept instance

4.16
generalization
specialization/generalization relationship in which an object class of a specialized element (child) is substituted for a generalized element (parent)

4.17
information model
graphical representation that logically organizes various data concepts by depicting key relationships among the data concepts

EXAMPLE An information model might specify that a Vehicle may be described by a variety of properties, such as: Make, Model, Year, and Vehicle Identification Number. Likewise a Collision might be described by properties such as Time of Occurrence, Severity, and Number of Vehicles Involved. Finally, the model might depict that a Collision has a many-to-many relationship to a Vehicle.

NOTE 1 Within the scope of this International Standard, information models are depicted using UML Class Diagrams.

NOTE 2 This International Standard uses the term information model in order to reflect the fact that relationships give the data a context and thereby transforms data into information. Some groups use the term data model. See also data model.

4.18
interface dialogue
data concept; collection of all the temporal sequences of messages, including variants such as multiple responses, that are used to accomplish the services that the interface dialogue provides

4.19
message
data concept; grouping of data elements and/or data frames, as well as associated message metadata, that is used to convey a complete unit of information

NOTE For the purposes of this International Standard, a message is an abstract description; it is not a specific instance.

4.20
message instance
occurrence of a message containing the actual values for the data elements and, in some cases, data about the message

4.21
meta
word denoting a description that is one level of abstraction above the concept being described

4.22
meta attribute
any documenting characteristic of a data concept

4.23
metadata
data that defines and describes other data

4.24
name
indexical term used by humans as a means of identifying data elements and other data concepts

4.25
object class
data concept; construct used to represent any kind of object (also referred to as an entity) within a ITS/TICS information environment

4.26
property
data concept; documenting characteristic of an object class used to group and differentiate individual objects

4.27
semantics
meaning, including concept(s), associated with a given data concept

4.28
syntax
structure of expressions in a language and the rules governing the structure of a language

4.29
value domain
data concept; expression of a specific and explicit representation of some information about something of interest within the ITS/TICS domain

5 Symbols and abbreviated terms

ASN.1	Abstract Syntax Notation One
ANSI	American National Standards Institute
CASE	Computer-Aided Software Engineering
CCC	(ITS/TICS Data Registry) Change Control Committee

DCI	Data Concept Identifier
DD	Data Dictionary
DR	Data Registry
ExCom	(ITS/TICS Data Registry) Executive Committee
ID	identification
IEC	International Electrotechnical Commission
IOS	Information Object Specification
ISO	International Organization for Standardization
ITS	Intelligent Transport System(s)
N/A	not applicable
OID	object identifier
OSI	Open System Interconnection
TC	Technical Committee
TICS	Transport Information and Control System(s)
UML	Unified Modeling Language
URL	Uniform Resource Locator

6 Concept of operation

6.1 Summary

The scope of ITS/TICS applications covers numerous ISO/TC 204 functional areas as well as national and regional ITS/TICS organizations, each having an established group of stakeholders. The international integration of ITS/TICS applications is one of the major development issues, so that data defined and gathered in one of these functional areas (e.g. traffic management, traveller information) can be applied in another. For this type of interoperability the definition of data that can persist across different functional areas must be standardized. The ITS/TICS Data Registry and ITS/TICS Data Dictionaries meet this requirement.

The ITS/TICS Data Registry/Data Dictionary system supports the harmonization of data concepts (e.g. data elements) from different stakeholder groups. The ITS/TICS stakeholder community is large and diverse as evidenced by the number of working groups within ISO/TC 204 and the number of national or regional ITS bodies participating. The definition of key data elements will arise from numerous sources. Moreover, different groups will have an interest in the definition of the same data concept, which could lead to the prospect of duplicate or similar definitions being developed.

The architecture of the ITS/TICS Data Registry and ITS/TICS Data Dictionaries is based on the specification of ISO/TC 204 working group (functional area) Data Dictionaries that support the data definition process of ISO/TC 204 working groups, as well as national or regional ITS Data Dictionaries that document their data definitions. In addition, the central ITS/TICS Data Registry supports standardization and harmonization processes that facilitate the different working groups and national or regional authorities to share data element definitions and avoid duplication.

The complete ITS/TICS distributed system will be very large, both in geographic extent and in the number and diversity of the application areas, inevitably leading to the independent development of sub-systems. In this context, a second major purpose of the ITS/TICS Data Dictionaries and the ITS/TICS Data Registry is to document and register information at interfaces. This process provides the main foundation for interoperability, by also focusing on those data elements which cross an interface, but which are not necessarily harmonized throughout ITS/TICS. The semantics of data elements may documented by recording the associations of the information models in which they participate.

The operational concept of the data registration is described in the following subclauses. See Annex A for specific procedural details.

NOTE There may be regional and national variations of this concept of operations.

6.2 Framework

The overall framework for the ITS/TICS Data Registry and ITS/TICS Data Dictionaries is presented in Figure 1. It illustrates the relationships among the:

— ITS/TICS architectures (and information models),

— ITS/TICS Data Dictionaries (that are intended to include all data concepts),

— The ITS/TICS Data Registry, and

— ITS/TICS Applications.

For each of these physical elements, the diagram also lists their key functions. For Data Dictionaries, the Data Registry and the applications it further identifies the key stakeholders or stakeholder groups that participate in or manage their operations. Finally, the diagram illustrates the information exchanged between these operational elements.

The ITS/TICS Data Dictionaries shall contain data concepts based on information flows documented in an ITS/TICS Architecture. (Note that there may be multiple architectures, each with multiple versions that are referenced.) Each data concept in a Data Dictionary should reference one or more flows of information between specific objects documented in a specific version of an ITS/TICS Architecture, the primary architecture being as defined in ISO/TR 14813-2:2000[7]. Regional and National architectures are also accommodated, This includes the application of the registry using data concepts from alternative International, Regional or National system architecture methodologies or techniques. This will ease migration and interoperability between such approaches.

Each referenced flow should be characterized by a source entity, information exchanged and destination entity. The referenced architecture defines the information exchange requirements and the relevant Data Dictionary further defines the syntax and semantics of the data representation of that architecture information exchange requirement.

The Data Dictionaries in Figure 1 may be developed, for example, by ISO/TC 204 or regional or National Standards Development Organizations (SDOs), public agencies, or private companies. These Data Dictionaries are the responsibility of their respective SDOs, regional or National bodies. Each Data Dictionary shall be associated with a data steward and/or data submitter, using the process defined in this International Standard, to submit data concepts from their respective Data Dictionaries to the ITS/TICS Data Registry. Furthermore, these Data Dictionaries should use registered data concepts from the ITS/TICS Data Registry rather than invent new data concepts. The use of such registered data concepts will help to avoid redundancy in data concepts.

The ITS/TICS Data Registry shall be the repository for submitted data concepts. Through the efforts of the data stewards, the registrar and the Data Registry change control committee (CCC) support identification of harmonization opportunities, recommendations for harmonization, and promotion of data concepts to higher quality levels where warranted. Finally, the Data Registry can provide data concepts to developers and other users for use in ITS/TICS applications.

Developers and other users should use data concepts from the Data Registry at the highest (*Preferred*) quality level. The data concepts at this level are described unambiguously, harmonized across ITS/TICS sectors, and are considered representative of published data standards.

Table 1 presents a summary of the distinguishing characteristics between Data Dictionary and a Data Registry within the ITS/TICS sector.

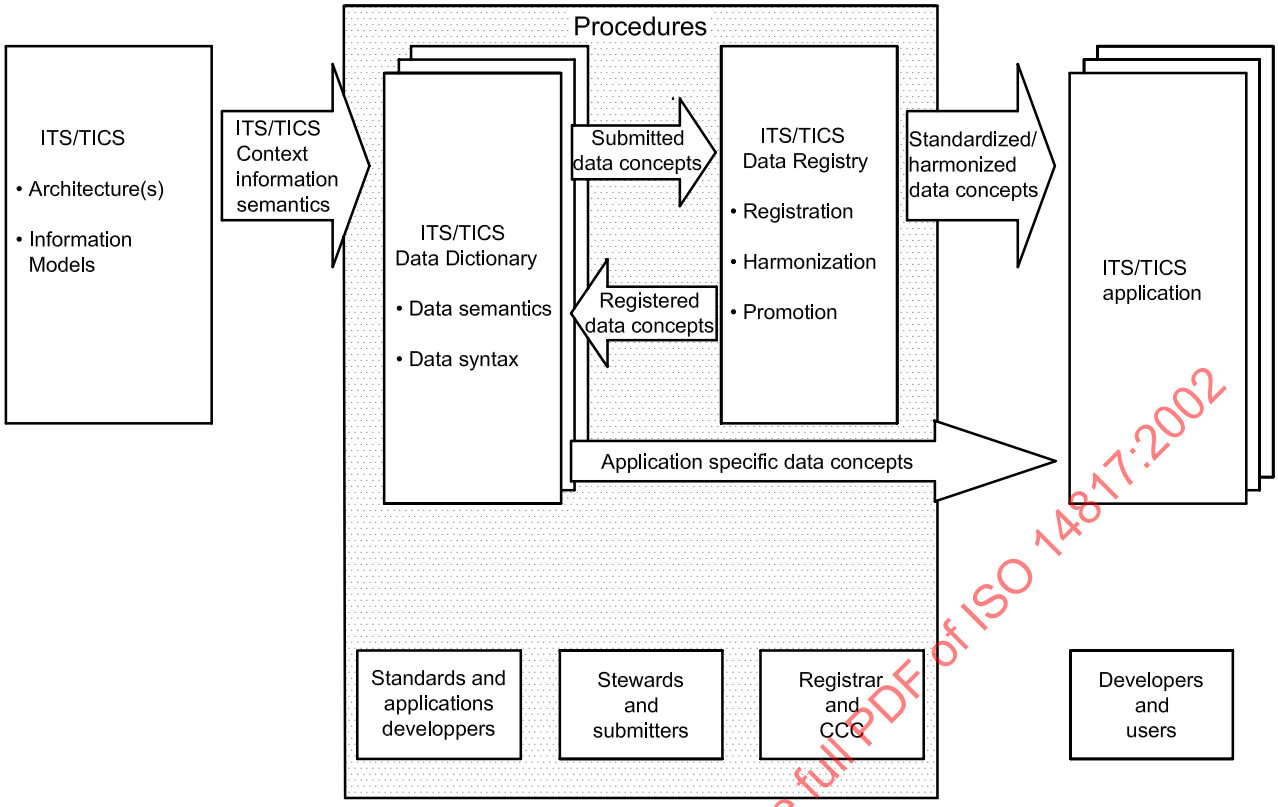


Figure 1 — ITS/TICS Data Registry operational framework

Table 1 — Data Dictionary/Data Registry distinguishing characteristics

ITS/TICS Data Dictionary	ITS/TICS Data Registry
Multiple Data Dictionaries	One (International) Data Registry
Covers single functional area	Covers multiple functional areas
Managed by a functional area steward	Managed by the CCC
Harmonized within the functional area	Harmonized across the ITS/TICS sector
Unique ID within functional area	Unique ID across the ITS/TICS sector

6.3 Organizational roles

6.3.1 Overview

Organizational roles associated with the ITS/TICS data registration process shall be established. The organizational roles shall include the ITS/TICS DR Executive Committee (ExCom), the ITS/TICS Change Control Committee (CCC), the ITS/TICS Registrar, ITS/TICS Stewards and ITS/TICS Submitters. A summary of each role is provided in this clause. Annex A provides a description of the purpose, specific responsibilities, and membership or selection criteria for each role.

Figure 2 provides a high level view of how these organizational roles are related within the context of the ITS/TICS Data Registry.

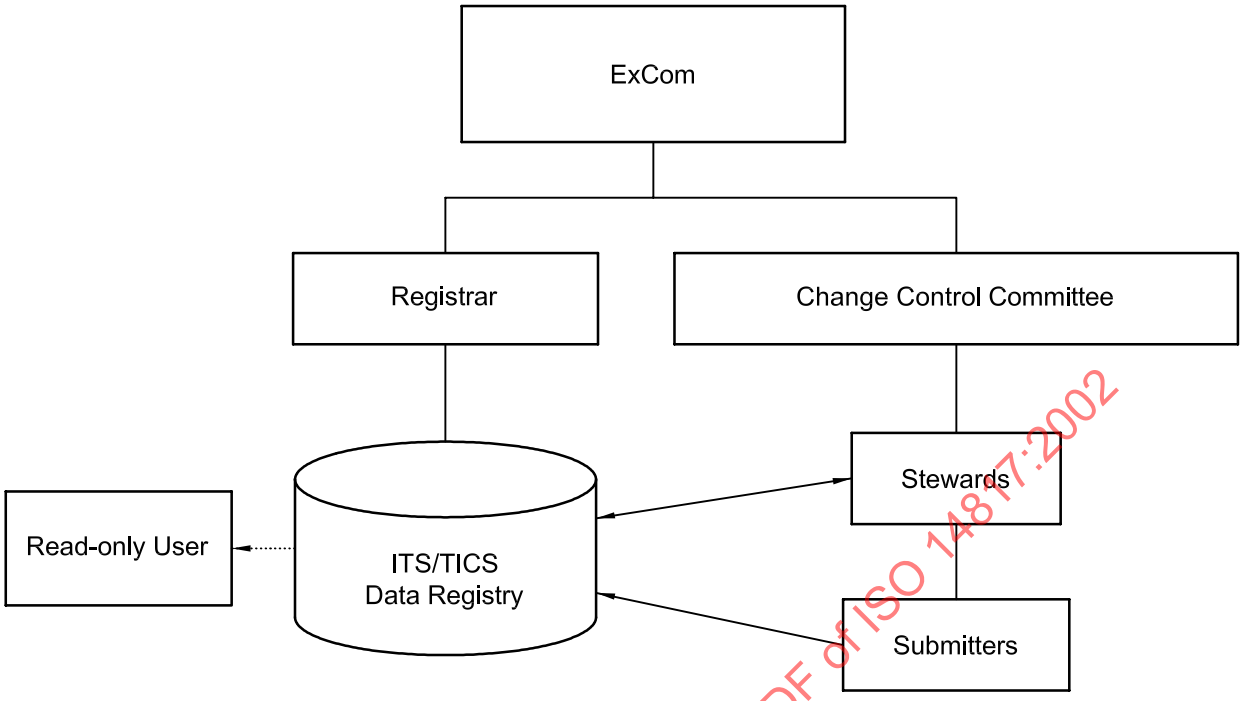


Figure 2 — Organizational roles to the ITS/TICS Data Registry and their relationships

6.3.2 Registration Authority

The ITS/TICS Registration Authority shall be in accordance with the ISO/IEC Directives, Part 1 (2001), Annex H.

6.3.3 Registrar

The ITS/TICS Registrar shall be an organizational element, expert in data registration processes, responsible for facilitating the registration of ITS/TICS data concepts and making those data concepts widely accessible and available to the ITS/TICS community. The ITS/TICS registration authority shall appoint the Registrar.

6.3.4 Steward

An ITS/TICS Steward shall be an organizational element of the ITS/TICS community such as a WG Convenor or his designated representative. Stewards are responsible for the accuracy, reliability, and currency of descriptive metadata for data concepts at a registration status level of Qualified or above within an assigned functional, regional or national area. Stewards are approved by a process defined by the registration authority. Stewards are responsible for data within ITS/TICS sectors and may have responsibilities that cut across multiple ITS/TICS functions (e.g. value domains such as date, time, location, codes of the countries of the world).

6.3.5 Submitter

An ITS/TICS Submitter shall be an organizational element recommended by an ITS/TICS Steward and approved by a process defined by the ITS/TICS registration authority. A submitter is authorized to identify and report data concepts suitable for registration. Such Submitters may be Stewards or National Bodies.

6.3.6 Read-only user

An ITS/TICS Read-only User shall be an organizational element or individual that is approved to review the contents of the ITS/TICS Data Registry. A read-only user submits a request for access. Access is approved by the CCC or organizational element designated by the ExCom. A read-only user has access to all the ITS/TICS sector contents in the Registry, but is not permitted to submit, alter, or delete contents.

6.3.7 ITS/TICS change control committee

The ITS/TICS Change Control Committee (CCC) shall be the organizational element that is constituted to provide technical direction and harmonization of data contents for the ITS/TICS Data Registry. The structure, staffing, procedures, and membership of the CCC are determined by the ITS/TICS ExCom. The membership of the CCC should include the ITS/TICS Stewards.

6.3.8 ITS/TICS executive committee

The ITS/TICS Executive Committee (ExCom) shall be an organizational element established by ISO/TC 204. It shall be responsible for administering responsibilities and authority delegated by the ISO/TC 204. Responsibilities of the ExCom shall include overall metadata registration policies and business direction of the ITS/TICS Data Registry. Reporting responsibilities to TC 204 shall be specified. Approval of ExCom procedures and practices shall be subject to review and approval by TC 204 or its designated organizational component.

6.4 Registration status levels

6.4.1 Summary of registration status levels

Registration status levels shall apply to individual data concepts that have been entered into the ITS/TICS Data Registry. Data concept registration status levels shall be of five levels: Card, Draft, Recorded, Qualified, and Preferred. The relationships among these status levels, along with the requirements for a data concept to achieve a particular registration status level, are presented in Table 2.

Table 2 — ITS/TICS registration status levels and criteria

Data concept status level	Status criteria
Preferred	Change Control Committee confirmation that a data concept is preferred for use in the ITS/TICS community.
Qualified	Change Control Committee confirmation that all mandatory attributes are completed and conform to quality requirements.
Recorded	All mandatory meta attributes for the data concept have been input.
Draft	At least the meta attributes Descriptive Name and Submitter Organization have been completed.
Card	At least the meta attributes of Descriptive Name, Submitter Organization, Submitter Phone Number have been completed.

While the general intent is to progress as many data concepts as possible from Draft to the Preferred registration status, progression to a status higher than Recorded or Qualified may not be appropriate. That is, necessary meta attribute documentation for a data concept may not be available to establish required documentation for the Recorded status, may not be of the quality necessary for the Qualified status, or identification as Preferred data concept may not be appropriate. Such data concepts shall be held at their current status level in the Registry to facilitate understanding of and access to these data concepts by the ITS/TICS community.

6.4.2 Description of registration status levels

The status level of a data concept entry shall be based upon the completeness of the data entered, its accuracy, and its conformance to the established format and syntax. The registration status levels shall be as listed below.

a) Card - A data concept in the Card status shall indicate that the Submitter wishes to make the ITS/TICS community aware of the existence of a data concept in their local domain. A data concept in the status of Card in the ITS/TICS Data Registry shall be maintained under version control within the submitters Data Dictionary. The Submitter may remove a data concept in the status of Card from the Registry at any time. The minimum meta attribute documentation for the Card status in the ITS/TICS Registry shall be: Descriptive Name, Submitter Organization Name, Submitter Phone Number, and Submitter Email Address.

b) Draft - A data concept in the Draft status shall indicate that the submitter wishes to propose it for progression up the ITS/TICS Data Registry registration levels. Data concepts in the Draft status are not maintained under version control, which means that updates will completely replace the original entry without retaining a record of the original. The Submitter may request the retirement of a data concept in the Draft status at any time, which will completely remove the data concept from the active Registry. The minimum meta attribute documentation for the Draft status is Descriptive Name and Submitter Organization Name.

c) Recorded - A data concept in the Recorded status shall indicate that the Submitter has completed entries in all mandatory meta attributes. A data concept in the Recorded status implies that the data concept may be shared across ITS domains. The contents of the mandatory meta attributes may not conform to quality requirements. The Submitter may retire a data concept in the registration status of Recorded at any time. Data concepts in Recorded registration status or higher are maintained under version control.

d) Qualified - A data concept in the Qualified status shall indicate that the CCC has confirmed that the mandatory meta attributes are complete and conform to applicable quality requirements. In the event that a data concept is not approved by the CCC for the Qualified registration status level, it shall remain at the Recorded registration status level.

e) Preferred - A data concept in the Preferred status indicates that the CCC confirms that the data concept is preferred for use in the ITS/TICS community. The descriptive name and ASN.1 name shall both conform to the ITS/TICS requirements.

6.5 Procedures

The ITS/TICS Registration Authority shall establish the necessary procedures to accomplish the following functional activities:

a) Submission of data concepts for registration — Submitters shall submit data concepts for entry into the ITS/TICS Data Registry. These data concepts may be recorded as Card or Draft registration status, as the Submitter deems appropriate. A registration status of Card implies usage restricted to the Submitter's domain while being posted for informational purposes. The Draft status implies that the submitter intends to progress the data concept to higher ITS/TICS registration status levels. Submitters or Stewards may progress data concepts in the Draft status to the Recorded registration status by completing all mandatory meta attributes required of that data concept.

b) Progression of data concepts — Submitters shall progress data concepts to Recorded status. Progression of data concept to registration status of Qualified or higher shall require the sponsorship of a Steward and approval of the Change Control Committee.

c) Harmonization of data concepts — The objective of harmonization is to resolve any potential duplicate or overlapping of data concepts. Procedures shall be established to facilitate data concept harmonization and reuse.

d) Modification of data concepts — Procedures shall be established to change data concepts.

e) Retirement of data concepts - Procedures shall be established to retire data concepts.

f) Administrative processing - The ITS/TICS Data Registrar may assign administrative registration statuses in order to track an interim state of a data concept.

NOTE This clause introduces the requirements for procedures associated with the ITS/TICS Data Registry and ITS/TICS Data Dictionaries. These procedures require organizational participation of certain roles, as specified in 6.3, in dealing with data concepts to be registered in the ITS/TICS Data Registry, as identified in Clause 7. Annex A provides representative procedures to address these functional requirements. Annex F provides guidance on the documentation of data concepts in preparation for submission to the Data Registry for registration.

6.6 Version control

6.6.1 Version maintenance

This subclause presents the requirements for synchronization of the meta attribute structures of the ITS/TICS Data Dictionaries and ITS/TICS Data Registry.

Configuration versions of the ITS/TICS Data Registry shall be maintained for meta attributes.

A “Current Version” and a “Development Version” shall be established and maintained for attributes of the ITS/TICS Data Registry. If TC204 working groups, regional and National bodies want to maintain consistency of their Data Dictionary meta attributes with those of the ITS/TICS Data Registry, the versioning procedures below shall apply.

6.6.2 Current version

The current version shall consist of those attributes approved by the CCC for current use in ITS/TICS Data Dictionaries and the ITS/TICS Data Registry.

6.6.3 Development version

The development version shall consist of those meta attributes under development, together with pertinent current version meta attributes, for use in ITS/TICS Data Dictionaries and the ITS/TICS Data Registry as the next current version. The CCC controls the release of each development version as the new current version. If TC204 Working Groups or regional or national bodies elect to keep their Data Dictionaries synchronized with the ITS/TICS Data Registry, they shall convert to the next version of the ITS/TICS Data Registry.

7 Data concepts

NOTE The term “data concept(s)” is used throughout the document to mean “types of data concept(s)”.

7.1 Summary of data concepts

This clause defines and explains the nine data concepts applicable to this International Standard. Data concepts refer to abstractions and things in the natural world that can be identified with explicit boundaries and meaning. The properties and behavior of these fundamental constructs all follow the same set of rules. Within ITS/TICS, there may be data concepts to represent, for example, a Bus Route and relevant information about it.

Data concepts include interface dialogue, message, data frame, object class, association, property, data element concept, value domain, and data element. See F.4 for an ASN.1 Information Object Specification (IOS) for an ITS/TICS data concept. Figure 3 presents a framework for data concepts and how they relate to one another. For illustration purposes, the braces, i.e. “{” and “}”, portray the particular relationships among the data concepts. The numeric annotation associated with each brace indicates the number of each data concept that may be realized. For example, there may be from 2 to n messages within an interface dialog, where n is any integer number. As another example, a message may consist of 0 to n data elements and 0 to n data frames.

Figure 4 presents interface data concepts and their relationships. Information interchange between two ITS/TICS system components shall be characterized from the top down as an interface dialogue or a set thereof. Interface dialogues shall be a set of messages whose order and timing for transmission is predicated upon a defined operational concept or scenario containing timing information. Messages shall be a collection of data elements and/or data frames which contain the substantial data to be exchanged.

Figure 5 presents model data concepts and their relationships. In support of the information interchange data concepts, additional data concepts for modeling are provided. These modelling concepts support the realization of the organization of the various data concepts by characterizing key relationships among the data concepts. See Annex E.

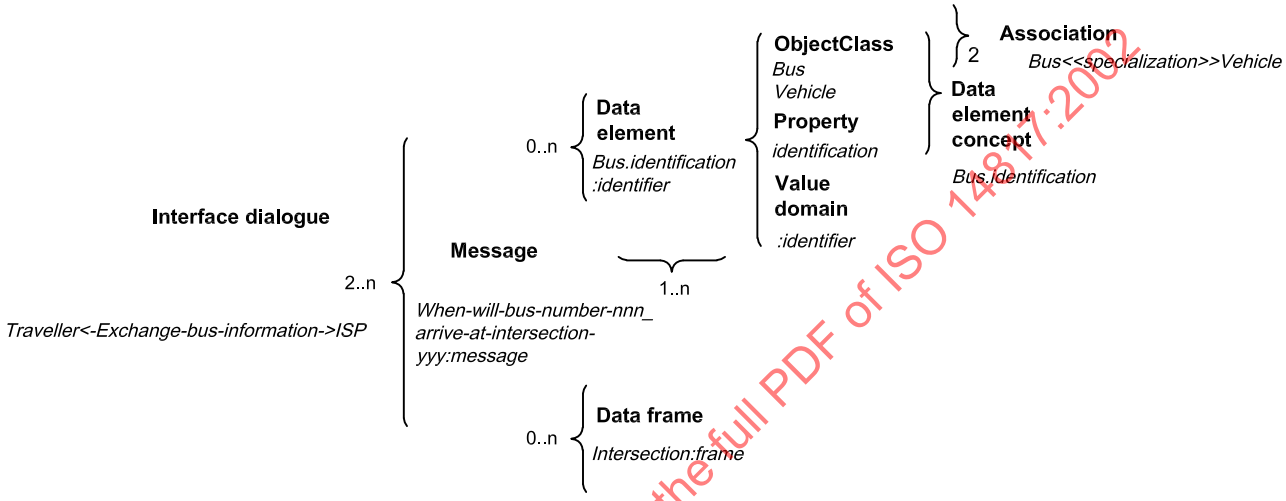


Figure 3 — ITS/TICS data concepts framework

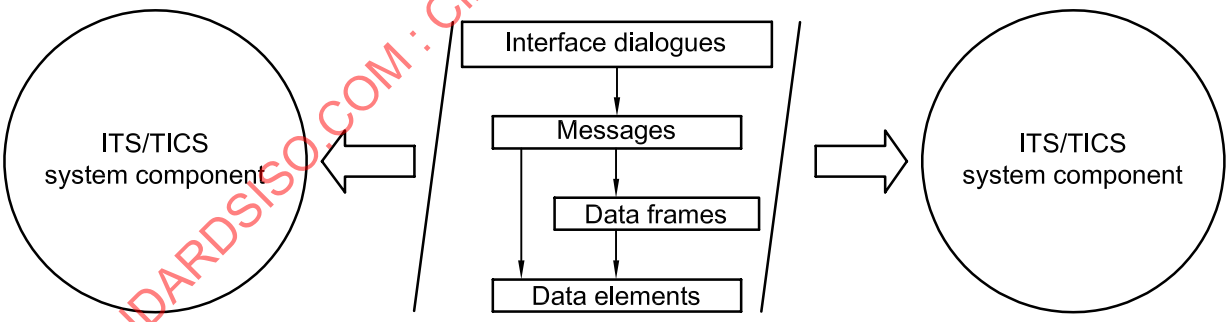


Figure 4 — ITS/TICS interface data concepts

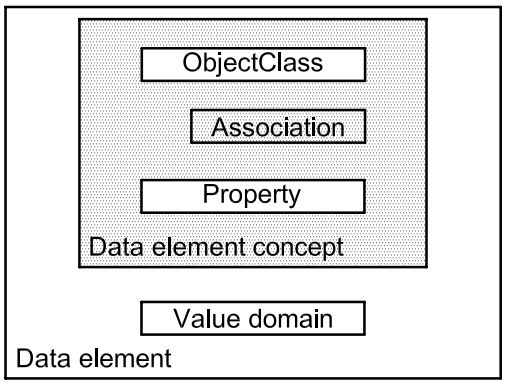


Figure 5 — ITS/TICS model data concepts

7.2 Interface dialogue

An interface dialogue shall be a temporal sequence of messages, including variants, among two or more system components that are used to accomplish a service/observable result. In Figure 3 the interface dialogue example is “Traveller<-Exchange-bus-information->ISP”

7.3 Message

A message shall be a structured grouping of data elements and/or data frames. In Figure 3 the message example is “When-will-bus-number-nnn-arrive-at-intersection-yyy:message.” See F.7 for an example ASN.1 Information Object Specification of a message.

7.4 Data frame

A data frame shall be a structured grouping of data elements primarily for the purpose of referring to a group with a single name to efficiently reuse such groups of data elements that commonly appear together in a message specification. In Figure 3 the data frame example is “Intersection:frame.” See F.6 for an example ASN.1 Information Object Specification of a data frame.

7.5 Object class

An object class shall be a description of a set of objects that share the same properties, relationships and semantics within a given domain of discourse about which there is a need to represent some information. Modifiers that qualify or further specialize the object class may be used. An object class is one of three data concepts used to characterize a data element. In Figure 3, the object classes illustrated are “Bus” and “Vehicle”.

7.6 Association

An association shall be a structured relationship between two object classes. A particular type of association is called a composition in which an object of the “whole” class is in a “whole/part” relationship with objects of the “parts” class. Modifiers may be used to show a composition. In Figure 3, the association example is “Bus<<specialization>>Vehicle.”

When an object class participates in an association, it has a specific role that it plays in that relationship. See Annex E for information modeling considerations.

7.7 Property

A property shall indicate information of interest that applies to one or more object classes. The information of interest might be a fact, proposition, or observation about each object of the class. A property is one of three data concepts used to characterize a data element. In Figure 3, the property example is “identification”.

7.8 Data element concept

A data element concept shall consist of a object class and a property. While in a form similar to a data element, a data element concept is devoid of a value domain or representation. In Figure 3, the data element concept example is “Bus.identification”.

7.9 Value domain

A value domain shall be a term that indicates, precisely and unambiguously, the format and syntactic form for data concept instance values. A value domain is one of three data concepts used to characterize a data element. In Figure 3, the value domain example is “:identifier”.

7.10 Data element

A data element shall be a formalized representation of some information (i.e., a property; e.g., a fact, proposition, or an observation) about an object class (e.g. a person, place, process, concept, association, state, or event), with an explicit value domain. A data element (a data concept) shall be characterized by three data concepts (see Figure 3): object class, property, and an explicit value domain descriptive name (and value domain reference, where applicable, describing the physical form of the information). In Figure 3, the data element example is “Bus.identification:identifier”. See F.5 for an example ASN.1 Information Object Specification of a data element.

8 Data concept meta attributes

8.1 Basic meta attributes of data concepts

8.1.1 Meta attribute categories

The basic meta attribute categories of identification, definitional, relational and representational shall be used in the ITS/TICS Data Registry and ITS/TICS Data Dictionaries. The definition of each meta attribute is provided in Annex B. See Annex C for meta attribute applicability to various data concepts.

NOTE These basic meta attributes may be represented in one or more (meta) data models to reflect more completely the relationships among the data. While selected meta attributes are based upon ASN.1 syntax for data representation, alternative (meta) data models may result in alternative syntax. Consequently, additional meta attributes to support other syntaxes (e.g. CORBA IDL, EDIFACT Graphical Syntax, XML Schema) may be added in future revisions and some existing mandatory attributes may become optional.

8.1.2 Identification meta attributes

Identification attributes shall differentiate one data concept from another. For example, the Data Concept Identifier together with Data Concept Version is a unique identification “tag” for a data concept within the ITS/TICS Data Registry. The ASN.1 Object identifier is also a unique identifier for each data concept. Other identification meta attributes may be used, e.g. Descriptive name and Synonymous Descriptive Name, for identification purposes but may be less precise. See B.2.

The identification meta attributes shall be as identified below.

— Data concept identifier

— Data concept version

— Descriptive name

— Synonymous descriptive names

— Symbolic names

— ASN.1 name

— ASN.1 object identifier

— Uniform resource locator

8.1.3 Definitional meta attributes

Definitional meta attributes shall describe the semantic aspects of a data concept. These meta attributes may directly address semantic meanings (e.g. Definition, Remarks) or indirectly provide insights into the semantic aspects of a data concept (e.g. Descriptive Name Context, Source, Data Concept Type). See B.3.

The definitional meta attributes shall be as identified below.

— Definition

— Descriptive name context

— Symbolic name usage

— Source

— Architecture reference

— Architecture name

— Architecture version

— Data concept type

— Remarks

— Context

— Standard

— Metadata source

— Priority

— Frequency/message mode

— Delivery verification

— Data quality

8.1.4 Relational meta attributes

Relational meta attributes shall document associations among or between data concepts. See B.4.

The relational attributes shall be as identified below.

— Precursor

— Successor

— Synonym

— Abstract

— Roles

— Multiplicity

— Association constraints

— Aggregate

— Role key

— Referenced messages

— Referenced data frames

— Referenced data elements

— Referenced object classes

— Referenced associations

8.1.5 Representational meta attributes

Representational meta attributes shall describe requirements for physical representation of data elements and value domains. These meta attributes shall define how data elements or value domains appear in databases or user interfaces, and constrain allowable processing activities. See B.5.

The representational meta attributes shall be as identified below.

— Data type

— Format

— Unit of measure

— Valid value rule

8.2 Administrative meta attributes

Administrative meta attributes shall describe management and control aspects associated with a data concept. For example, Last Change User identifies the user that last changed a data concept. Registration Status identifies the status level of a data concept

The administrative meta attributes identified below shall be used in the ITS/TICS Data Registry to facilitate administrative management of ITS/TICS data concepts. These administrative meta attributes are optional for the ITS/TICS Data Dictionaries. See B.6 for definitions of these administrative meta attributes.

— Registration status

— Date registered

— Last change date

— Last change user

— Registrar organization name

— Registrar phone number

— Steward organization name

— Steward phone number

— Submitter organization name

— Submitter phone number

— User

— View

— Related groups

— Security class

9 Data concept names

9.1 Descriptive names

Descriptive names shall be formulated when developing data concepts. Requirements for developing descriptive names for data concepts, their component parts, and their abbreviations are described in Annex D. These requirements shall apply to the entire ITS/TICS data environment.

The descriptive name shall be a name that represents the meaning of a data concept. The descriptive name often serves as a synopsis of the data concept's definition. Abbreviated names are used primarily as physical names, and are also referred to as symbolic names, internal names, or access names in application database environments and application program interfaces or messages. When names are formulated by combining multiple terms that provide a more complete characterization of the data concept being named, then separators shall be used in various combinations to enhance readability. Use of these separators: period, colon, left caret, right caret, and dash is defined in Annex D.

The descriptive name shall be unique.

9.2 Data concept descriptive name formats

Descriptive names shall be constructed by combining the relevant component descriptive names with specific separators. The formats are shown Table 3.

Table 3 — Descriptive name formats for ITS/TICS data concepts

Data concept	Descriptive name format
Object class	ObjectClassTerm
Property	propertyTerm
Value domain	value-domain-term
Data element concept	ObjectClassTerm.propertyTerm
Data element	ObjectClassTerm.propertyTerm:value-domain-term
Data frame	DataFrameTerm:frame
Message	MessageTerm:message
Interface dialogue	SourceName<-InterfaceDialog->DestinationName
Association	RoleAObjectClassTerm <<associationtype>>RoleBObjectClassTerm

10 Meta attribute requirements for ITS/TICS data concepts

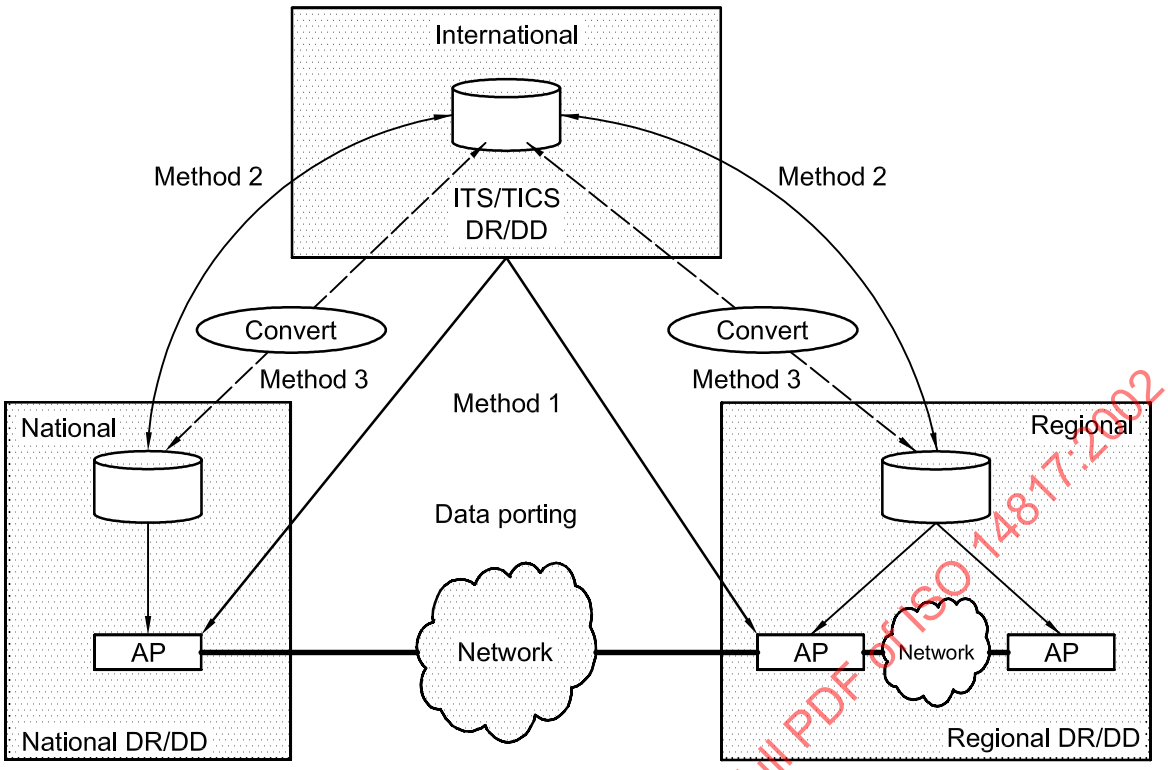
The ITS/TICS Data Registry and ITS/TICS Data Dictionaries shall consist of meta attributes for each data concept as delineated in Annex B. Annex C specifies the applicability of the meta-attribute to each data concept. C.2 provides specific requirements for the ITS/TICS Data Registry. C.3 provides specific requirements for an ITS/TICS Data Dictionary.

NOTE The meta attributes specified for the ITS/TICS Data Registry and ITS/TICS Data Dictionaries are not required for use in ITS/TICS application Data Dictionaries, although such use is encouraged.

11 International relationships

This International Standard recognizes that while the ITS/TICS sector is global in scope, National and regional Data Dictionaries and data registries are developed according to individual National and/or regional requirements as well as National and regional conditions. These National and regional Data Dictionaries and data registries take into consideration the cultural conventions relevant to the community of interest. For example, the Data Dictionary may contain data in the local language and may employ the local conventions for date, time, currency, etc. However, the global economy within a multimodal transport environment requires data portability. In order to maximize data portability and minimize data conversion to achieve international ITS/TICS information interchange, explicit relationships shall be established between the ITS/TICS (International) Data Registry/Data Dictionaries and the National and regional data registries and Data Dictionaries.

Figure 6 presents a top level view of that relationship. One of three methods shall be employed in exchanging data between the International ITS/TICS DR/DD and the National and/or Regional environment. Method 1 shall provide for a National application's direct access to the ITS/TICS DR/DD to acquire data concepts that have been internationally harmonized. Method 2 shall provide for a direct exchange of data concepts between the International DR/DD and the National/Regional DD/DR. Method 3 shall provide for an exchange of data concepts through a conversion process that recognizes established cultural conventions.



DR Data Registry
DD Data Dictionary
AP Application Program

Figure 6 — Reference model for national, regional and international relationships

Annex A
(informative)

ITS/TICS functional operating procedures

A.1 Introduction

This annex defines the overall concept of operations for the ITS/TICS Data Registry. It identifies specific ITS/TICS roles and responsibilities and provides specific functional operating procedures for the use of the Data Registry and interactions with the ITS/TICS DR functional or national Data Dictionaries. These procedures support standardization and harmonization processes that facilitate the different working groups and national or regional authorities sharing data concepts. See 6.3 for organizational roles and responsibilities (and their relationships), and 6.4 for registration status levels definitions.

A.2 Roles and responsibilities associated with the ITS/TICS Data Registry

A.2.1 Registrar

The Registrar provides a single individual point-of-contact responsible for managing and maintaining information about ITS/TICS data in the Registry, under the authority of the ITS/TICS Registration Authority. The Registrar is responsible for:

a) Monitoring and managing the Registry contents.

NOTE The Registry is established, operated, and maintained by the ITS/TICS Registration Authority.

b) Enforcing policies, procedures, and formats for populating and using the Registry.

c) Proposing procedures and standard formats for the Registry to the ITS/TICS DR CCC for consideration.

d) Recording current registration status for data concepts in the Registry.

e) Ensuring access for authorized users to contents in the Registry.

f) Assisting in the progression of data concepts through the registration status levels.

g) Assisting in the identification and resolution of duplicate or overlapping data concepts in the Registry.

h) Acting on direction from the ITS/TICS Registration Authority.

i) Effecting registration of ITS/TICS data concepts in external data registries or Data Dictionaries.

j) Enforcing data registration procedures for submitting data concepts to the Registry, e.g.

- How to prepare, submit, and process submissions of data concepts.
- How the Registry is used to avoid duplicate data concept submissions to the Registry.
- How the Registry is used to effect harmonization of data across Data Dictionaries of participating organizations.
- How external registries are used as a source of data concepts for reuse in the Registry.

k) Maintaining a separate document recording the appropriate contact information for all members of the CCC and the ExCom.

l) Adding new users or organizational entities that may become authorized to access the ITS/TICS Data Registry.

m) Maintaining other controlled word lists of the ITS/TICS Data Registry.

A.2.2 Stewards

Stewards provide specific expert points of contact responsible for coordinating the identification, organization, and establishment of registered data for use throughout the ITS/TICS enterprise within an assigned area.

Stewards are responsible for:

a) Co-ordinating the identification and documentation of data concepts within their assigned area.

b) Ensuring that appropriate data concepts in their assigned area are properly registered.

c) Co-ordinating with other Stewards to attempt to prevent or resolve duplicated efforts in defining data concepts.

d) Reviewing all data concepts once they are in the Recorded status to identify and attempt to resolve conflicts among data concepts with other Stewards' responsible areas.

e) Ensuring the quality of meta attributes for data concepts they propose for the Qualified registration status level, reusing standardized data from external data registries where applicable.

f) Proposing Preferred registration status level data concepts in their assigned area.

g) Ensuring that data registration procedures and formats are followed within their assigned functional area.

h) Recommending Submitters to the Registration Authority.

A.2.3 Submitters

Submitters are organization elements that are familiar with or engaged in development and operational environments. Submitters maintain current data concepts and are engaged to describe and submit new data concepts following the ITS/TICS data registration requirements.

A Submitter is responsible for:

a) Identifying himself to the Registrar in writing.

b) Identifying and documenting data concepts appropriate for registration in the Registry.

c) Submitting data concepts to the Registry.

d) Ensuring the completeness of mandatory meta attributes for ITS/TICS data concepts proposed for the Recorded registration status level.

A.2.4 Read-only users

A Read-only User is an organizational element approved by the Registrar to review the contents of the Registry. Read-only Users may not add to, delete from, or otherwise modify the contents of the Registry.

A.2.5 Change control committee

The ITS/TICS DR CCC provides overall technical direction of, and resolution of technical issues associated with, the Registry, its contents and its technical operations.

The ITS/TICS DR CCC is responsible for:

a) Overall conduct of ITS/TICS registration operations.

b) Promoting the reuse and sharing of data in the ITS/TICS Registry within and across ITS/TICS functional-areas, and among external interested parties to the ITS/TICS enterprise.

c) Progressing data concepts through Registry registration Qualified and Preferred status levels.

d) Identifying data concepts to be registered in external data registries or Data Dictionaries.

e) Resolving technical issues associated with registered data concepts, e.g., overlap, duplication, etc.

f) Approving updates to data concepts previously placed in the Registry in the Qualified or Preferred registration status levels.

g) Proposing Registry policies to the ExCom for approval.

h) Approving authorized Submitters, Read-only Users, and types of users, of the Registry.

i) Approving Registry content, procedures, and formats.

j) Submitting management-related recommendations and issues to the ExCom.

k) Acting on directions from the ExCom.

l) Meeting periodically in face-to-face meetings, with additional meetings and teleconferences held as needed.

The CCC will normally fulfil its responsibilities via consensus building in accordance with an established procedure. Intransigent issues may be resolved by an established procedure.

A.2.6 Executive Committee (ExCom)

The ITS/TICS ExCom is responsible for overall policy and business direction for the ITS/TICS Registry, to include:

a) Establishing overall Registry policies.

b) Resolution of all business management issues pertaining to the Registry, e.g. copyrights, stewardship, funding, ExCom membership, etc.

c) Ensuring the long-term success and performance of the Registry.

d) Establishing and updating the Registry charter and strategic plans.

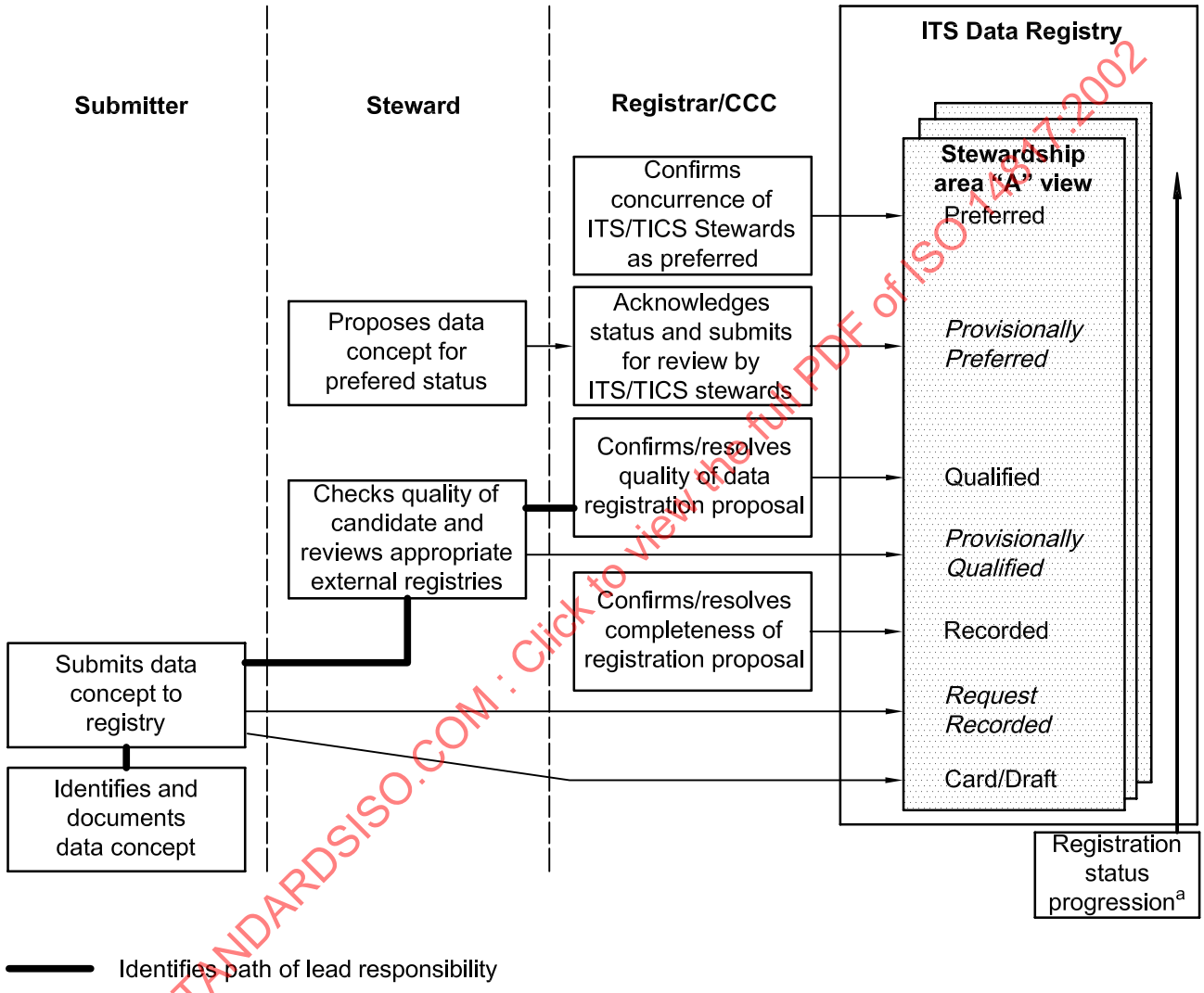
e) Meeting at least semi-annually in face-to-face meetings, with additional meetings and/or teleconferences held as needed.

The ExCom will normally fulfil its responsibilities via consensus building. Intransigent issues may be resolved by simple majority vote, one vote per member organization.

A.3 Registration concept of operations

A.3.1 Overview

The operational procedures for the ITS/TICS DR is summarized in this subclause. These procedures describe registration and harmonization practices for the ITS/TICS Data Registry. See 6.3 for organizational roles and responsibilities (and their relationships), and 6.4 for registration status levels definitions. This clause describes the registration activities associated with Submitters, Stewards, and the registrar and CCC roles. Figure A.1 summarizes these functional activities.



[a] Timing of registration status progression is entirely dependent upon the data Submitter/Steward. Card is not subject to progression.

Figure A.1 — Registration functional activities

A.3.2 Registration initiation

All Submitters accomplish the Submitter registration activities in the same way in accordance with these functional operation procedures so that data concepts are consistently and accurately registered. The responsibility of the Submitter is to propose and document data concepts for registration in the registration status of Draft; and, if desired, propose data concepts for the registration status of Recorded. A Submitter acquires an understanding of ITS/TICS data concepts, their context and sources, and their significance in the course of accomplishing normal operational, design, development, or management activities.

A.3.3 Quality review

The responsibility of the Steward, for data concepts in an assigned functional area, is to ensure that quality registration candidates are passed to the registrar for presentation to the CCC to be considered as Qualified data concepts. Stewards also may recommend data concepts for Preferred registration status.

A.3.4 Registry administration

The responsibility of the registrar is to co-ordinate the Registry environment and manage the Registry, making its contents as widely accessible as feasible. Administrative levels are established to track the progression of a data concept in the transition from one status level to the next.

a) Provisionally Qualified - A data concept in the Provisionally Qualified status indicates that a Steward has confirmed that the mandatory meta attributes are complete and conform to applicable meta attribute quality requirements. The Steward is authorized to promote data concepts at the Recorded status to the administrative status of Provisionally Qualified at such time as the Steward believes that all quality requirements have been achieved. Steward Organization Name is mandatory and the ASN.1 Name shall be unique in the ITS/TICS Data Registry for data concepts at Provisionally Qualified or higher quality status.

b) Provisionally Preferred - A data concept in the Provisionally Preferred status indicates that a Steward proposes the data concept as Preferred for general use in the ITS/TICS community; however, certification of Preferred status of the data concept by the CCC is not yet complete. The Steward is authorized to promote data concepts from the Qualified level to the Provisionally Preferred at such time as the Steward believes the data concept should be a preferred data concept.

c) Retired - A data concept in the Retired status indicates that the CCC has approved the data concept as no longer recommended for use in the ITS/TICS community. Data concepts in the retired status also includes data concepts in the Recorded status that the Submitter has retired. Such data concepts are retained in the Registry archival storage facility for historic reference purposes. The Retired status identifies data concepts no longer considered appropriate for use in the ITS/TICS community. Retired data concepts should include a reference (e.g. Successor meta attribute) to replacement data concepts when appropriate. Edits of Retired data concepts are not permitted.

A.4 ITS/TICS data registration procedures

A.4.1 Overview

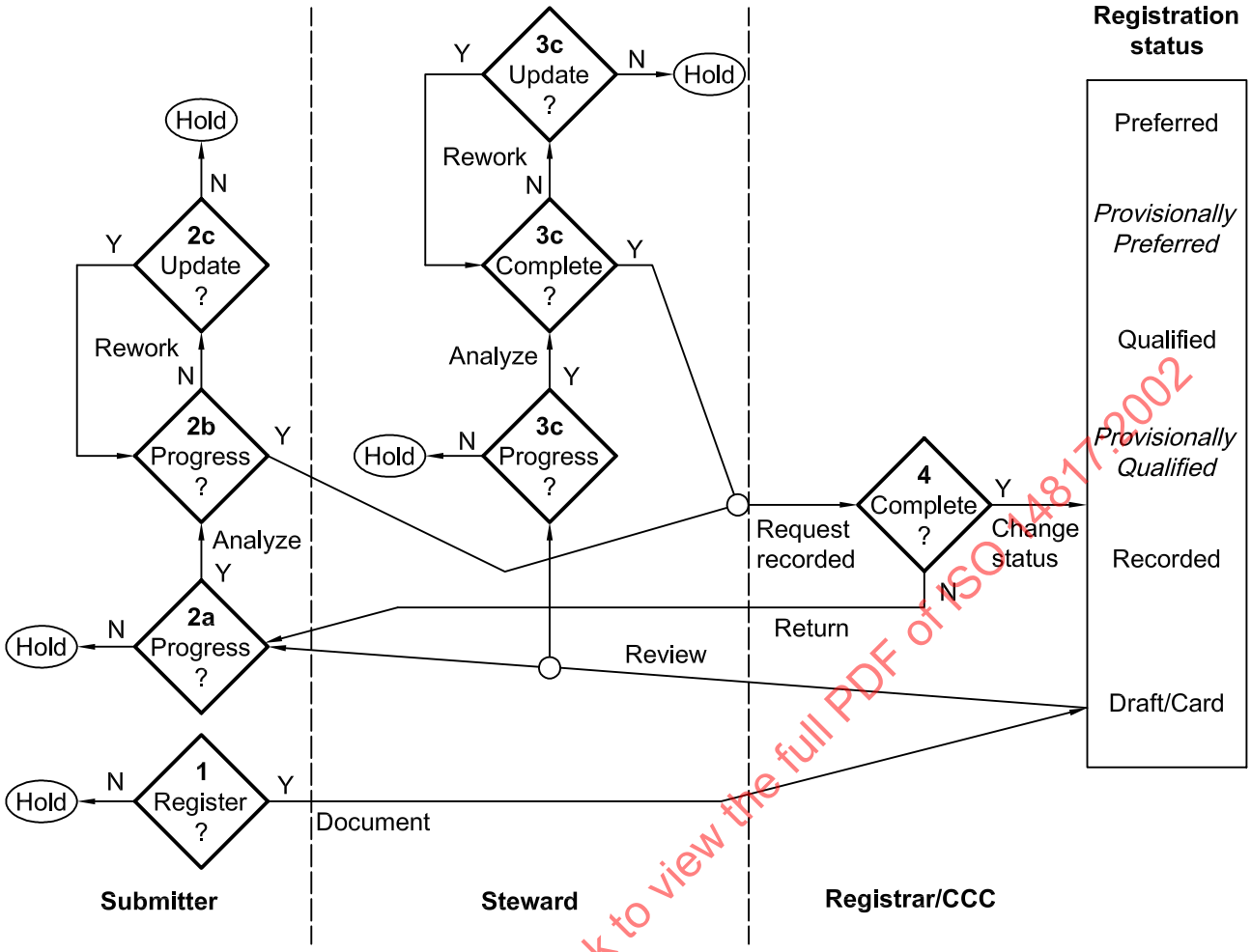
The ITS/TICS data registration procedures are described in the following subclauses. The step identifications are used in Figures A.2 and A.3 which is an illustration of this part of the procedure. They are illustrated in Figures A.2 and A.3

A.4.2 Card or Draft status data concepts

Step 1: Submitter identifies data concepts appropriate for these status levels in the course of normal activities. Submitter prepares a registration proposal documenting as many meta attributes as possible described in the standard. Submitter validates the ASN.1 module definitions through the use of an ASN.1 syntax checker. Submitter initiates this status for data concepts they submit to the Registry.

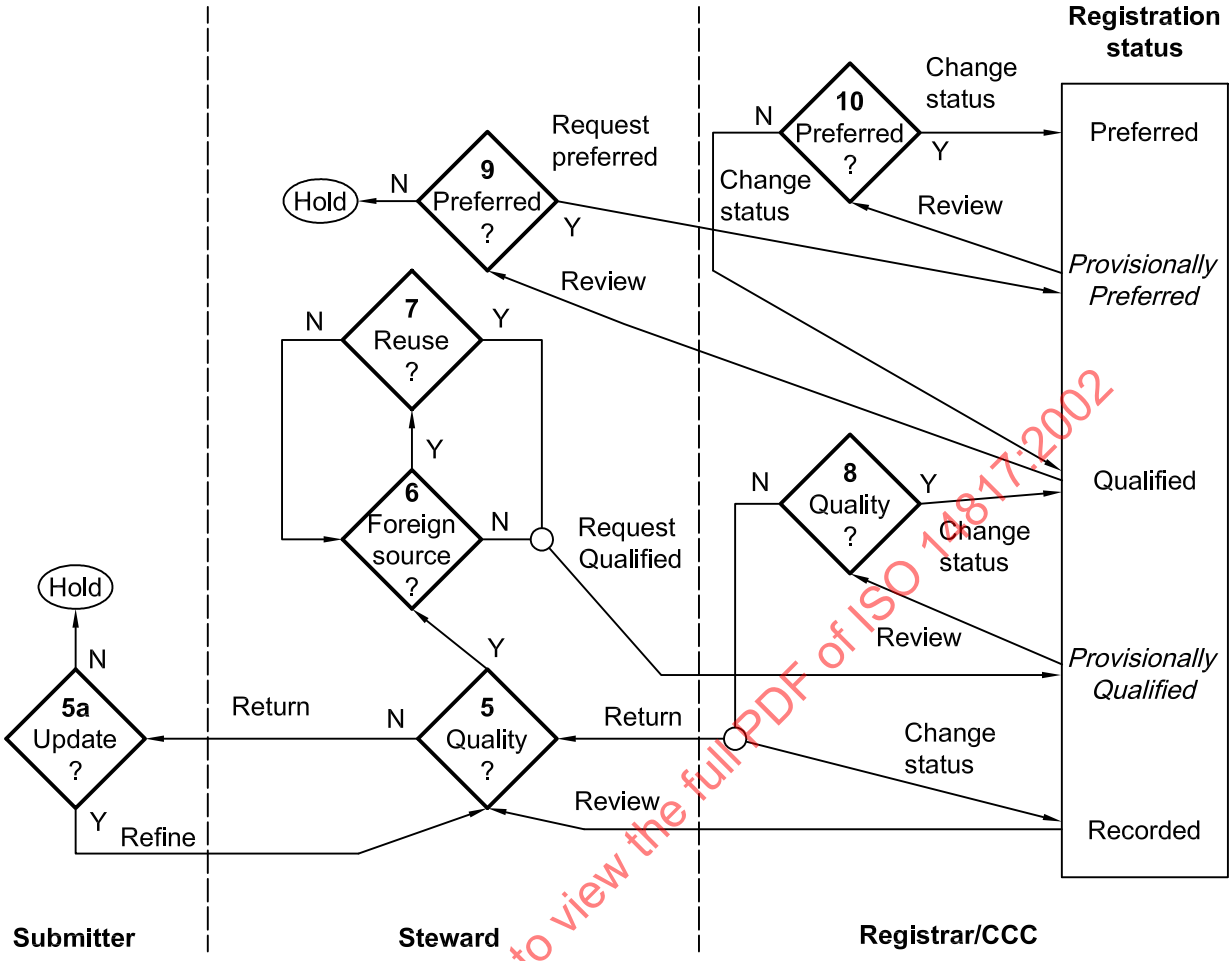
Step 2a: Submitter reviews data concepts to determine whether the data concept should be progressed from a Draft registration status. If the data concept is not to be progressed, it is held in the Registry in its current status level.

Step 3a: Steward also reviews data concepts at least quarterly to determine, in co-ordination with an appropriate Submitter whether a data concept should be progressed from a Draft registration status. If the data concept is not to be progressed, it is held in the Registry in its current status level.



NOTE Where the above diagram identifies a data concept going to a “hold” condition, this means that that data concept is held in its last approved registration status. “Hold” is not an additional registration status level.

Figure A.2 — ITS/TICS data registration process flow, Part 1



NOTE Where the above diagram identifies a data concept going to a "hold" condition, this means that that data concept is held in its last approved registration status. "Hold" is not an additional registration status level.

Figure A.3 — ITS/TICS data registration process flow, Part 2

A.4.3 Recorded data concepts

Step 2b: Submitter determines that a data concept should be progressed to Recorded registration status. The Submitter confirms that mandatory meta attributes are complete, updating the meta attributes as necessary (**Step 2c**). The Submitter then requests Recorded status for the data concept.

Step 3b: Steward determines that a data concept should be progressed to Recorded registration status. For such data concepts, the Steward confirms that mandatory meta attributes are complete, updating the meta attributes as necessary (**Step 3c**). The Steward then requests Recorded status for the data concept.

NOTE 1 Placement of any data concept from any national, regional, or ISO/TC 204 functional working group into the ITS/TICS Data Registry at Card or Draft Registration Status levels is entirely dependent upon the appropriate Submitter/Steward authority deciding to do so. Further, progression to any higher registration status level is also entirely dependent upon the interest of a Submitter or Steward to progress any such data concept. This means that it is up to the Submitter and/or Steward to propose promotion of data concepts when and if they choose to do so. No time line is specified in this International Standard by which any registration status progression must happen.

NOTE 2 Any data concepts registered in the ITS/TICS Data Registry are presumed to be retained for informational purposes regardless as to whether they are ever proposed for progression so that the ITS/TICS community can be aware of data concepts for possible reuse. Warning: data concepts at the Card or Draft registration status levels can be removed without notice by the original submitter.

Step 4: Upon request for Recorded registration status from either a Submitter or a Steward, the ITS/TICS Data Registry system checks that the mandatory meta attributes of the data concepts are present and changes the registration status to Recorded for data concepts with entries containing all mandatory meta attributes. If any mandatory meta attribute is missing an entry, the ITS/TICS Data Registry notifies the requester of the missing meta attribute(s).

A.4.4 Qualified data concepts

Step 5: The Steward, for those data concepts appropriate for progression to the Qualified registration status level, reviews the meta attributes for conformance to quality requirements of this International Standard and any other requirements as may be agreed to by the CCC as published as an ITS/TICS technical data management policy. If the meta attributes do not meet these quality requirements, the Steward assists the Submitter in achieving the quality requirements (**Step 5a**) by referring the Submitter to appropriate policies, procedures, and guidelines.

Step 6: The Steward checks pertinent external data registries or other external Data Dictionaries to determine if a data concept has already identified in another domain, outside of ITS, that fulfils the needs of the ITS/TICS community and is satisfactory to the original Submitter. The extent of this check of external sources of data concepts depends upon the Steward's knowledge of potential appropriate external sources. The Steward may consult with the Registrar, who will maintain and publish, at least quarterly, external registries or Data Dictionaries that have been found useful to the ITS/TICS community.

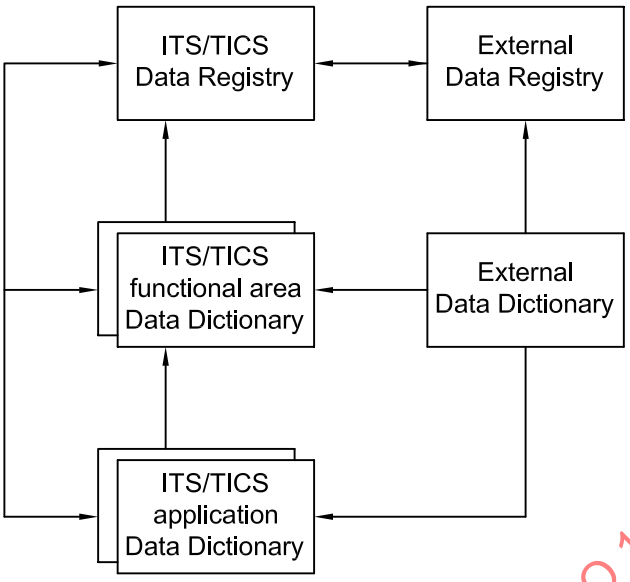
An overview of the external review process for Stewards is illustrated in Figure A.4

Step 7: If an external data concept is so identified (see Figure A.4), that external data concept is put forward and reused in lieu of the specific data concept proposed by the Submitter. The Steward will complete the following minimal meta attributes for the external data concepts reused in the ITS/TICS Data Registry: Descriptive Name, Definition, Registrar Organization Name and Registrar Phone Number (entries are made to record the external registrar or other data authority information), Synonymous Descriptive Name (the data concept's name in its native form as submitted by the Submitter), and Source (Enter the word "External"). External data concepts may be progressed up the registration status levels with only these minimal meta attributes completed. Once the data concept has had all appropriate meta attributes completed to quality requirements, the Steward updates the data registration status level for that data concept to the Provisionally Qualified status.

Step 8: The Registrar reviews all Provisionally Qualified registration status data concepts at least quarterly to re-verify completeness of mandatory meta attributes and to confirm quality requirements of the meta attributes for the data concept(s), including uniqueness of its identifier, quality of its descriptive name, as well as uniqueness of its ASN.1 name.

If quality requirements are met, the registrar shall progress the data concept to the Qualified status.

If quality requirements are not met, the registrar supports the Steward and the Submitter in taking any actions necessary to bring the meta attributes of the data concept to quality standards, if possible. If not, the data concept is retained on hold at the Recorded registration status level. Once such quality standards are achieved for appropriate meta attributes, the Registrar submits a listing of such data concepts proposed for Qualified registration status, together with all supporting meta attributes, to the CCC periodically for the CCC face-to-face meetings (or to the CCC electronic interim meetings, as directed) for approval as Qualified data concepts. If data concepts are not approved by the CCC to the Qualified registration status level, they are reverted to the Recorded registration status.



NOTE When data elements from foreign registries are reused in the ITS/TICS Registry, they may go in as Draft and be progressed to Recorded registration status in their native form (provided minimum meta attributes for external data concepts are completed).

Figure A.4 — External Data Dictionary/Data Registry relationships

A.4.5 Preferred data concepts

Step 9: Stewards will review Qualified registration status level data concepts at least quarterly with the view of possibly progressing a data concept to the registration status level of Preferred. For any data concepts so identified, the Steward updates the registration status level to Provisionally Preferred and provides the Registrar with a short statement as to why such data concepts should be progressed to the Preferred registration status level.

Step 10: The Registrar reviews all data concepts in the Provisionally Preferred registration status at least quarterly to confirm it as a viable Preferred data concept. The Registrar submits a listing of all data concepts proposed for the Preferred registration status, together with their meta attributes and the Steward's statement, to the CCC periodically at the CCC face-to-face meetings (or to the CCC electronic interim meetings, as directed) for approval as Preferred data. A key focus of review by the Registrar and the CCC is the identification and resolution of overlapping or redundant data concepts among the Stewards. The Registrar then changes the registration status level of approved data concepts to Preferred. If data concepts are not approved by the CCC to the Preferred registration status level, they revert to the Qualified registration status. If quality requirements are met, the registrar shall progress the data concept to the Preferred status

Final resolution as to Preferred registration status level may result in confirmation of the candidate as a new Preferred data concept, a new version of a previously Preferred data concept, or recognition of the candidate as already established in the Preferred status. In this case, or if the registered data concept has been previously established as a Preferred data concept in the Registry, the Steward and Submitter, as well as associated systems developers, will reuse such data concepts in their application development efforts. This resolution may also re-assign responsibility for the registered data concept to another Steward.

Once a registered data concept is established in the Preferred status and if recognition of the Preferred data concept is desirable in external registries, the Registrar will forward such Preferred data concepts to appropriate external registrars.

A.5 Change management procedures

A.5.1 Summary

The configurations of the contents of application Data Dictionaries or functional-area Data Dictionaries are the responsibility of the managers or administrators of those dictionaries. They may be informally managed using these change management procedures.

A.5.2 Change procedures for data concepts in the Registry

Procedures for proposing changes to a data concept in the Registry are the same as for new proposals, except that the Steward will involve the original Submitter of the data concept in the event a Submitter other than the original Submitter is proposing changes. Only the original Submitter of a data concept, or responsible Steward for data concepts at registration status of Qualified or higher, may edit a data concept. The ITS/TICS Data Registry will automatically notify Stewards recorded in the Relevant Groups meta attribute of any changes to data concepts in a Registration Status of Recorded by email. Changes to data concepts in a Registration Status of Qualified or higher may not be made without CCC approval. The Steward mediates any conflicts between Submitters associated with a proposed change. Similarly, when the proposal is forwarded to the Registrar, other relevant Stewards will be involved in review of the proposal and the Registrar will mediate any conflicts between the Stewards. The registrar reports data concept change proposals for data concepts at Qualified and above to the CCC with appropriate change of version or a new data concept due to substantive change in semantics or representational form of the data concept. Mere refinement of semantics, change to administrative meta attributes, or change of registration status do not result in version changes. Stewards will determine whether or not the semantics of a data concept have changed significantly enough to warrant a version change. Additions to code set values should result in version changes.

A.5.3 Retirement procedures for data concepts in the Registry

In the event a data concept in the Registry is proposed for retirement, generally the same procedures are followed as for data concept registration change proposals.

A data concept in the Registry might be proposed for retirement for a number of reasons, for example it might be superseded by a new data concept, it might be replaced by entirely new data concept in the Registry, or it might have been inappropriately placed in the Registry. Retired data concepts (except those in Card) will be linked to the superseding data concept, if any, by the Submitter or Steward in such a way that the effective date of superseding data is recorded (with Last Change Date) and a mapping of the old and new data concept in the Registry is preserved.

The status of a data concept proposed for retirement is changed to Retired by the registrar for data concepts in the Qualified registration status or higher after presentation to the CCC. The Submitter may change the registration status of data concepts at the Recorded levels to Retired at any time, without review by the CCC.

Retired data concepts are retained in the Registry, or the Registry archival storage, to provide historic contextual understanding of such data concepts. When data concepts are moved to Registry archival storage, their data concept identifier and descriptive name will be retained in the Registry itself.

A.5.4 Change management procedures

A.5.4.1 Applicability

The change management procedures of this section are applicable to the Registry and, optionally, for certain configuration items in the functional-area Data Dictionaries.

A.5.4.2 Identifying configuration items

The purpose of configuration item identification is to explicitly specify what data concepts are subject to change management.

ITS/TICS Data Dictionary configuration items are of two types: ITS/TICS data concepts, and meta attribute data concepts of the IT/TICS Data Registry, and (optionally) functional-area Data Dictionaries. Both types of configuration items are managed in accordance with these procedures.

A.5.4.3 ITS/TICS data concepts

Formal change management of ITS/TICS data concepts is accomplished only for managing changes to ITS/TICS data concepts at the Recorded, Qualified or Preferred registration quality levels. Changes to data concepts in the administrative registration status levels of the Retired status are not permitted. Data concepts at the Card registration quality level are not formally change managed in terms of CCC involvement or approval actions. Card entries are managed in their respective Data Dictionaries using ITS/TICS meta attributes.

ITS/TICS data concept configuration items are the data concepts documented in the Registry: i.e., data elements, data element concepts, object classes, properties, value domains, messages, data frames, interface dialogues, and associations. Configuration identification numbers for these configuration items are their data concept identifier plus data concept version number.

ITS/TICS data concepts in the functional-area Data Dictionaries or application Data Dictionaries are not formally change managed under the CCC, although they may be managed by the functional-area Data Dictionary authority using these procedures.

A.5.4.4 Meta attribute data concepts

Meta data configuration items are the meta attributes used to document ITS/TICS data concepts in the Registry and in functional-area Data Dictionaries. All meta attributes are change managed for the Registry and functional-area Data Dictionaries. Configuration identification numbers for meta attribute configuration items are their data concept identifiers and version numbers.

Formal change management of meta attribute configuration items in the functional-area Data Dictionaries may be necessary to ensure compatibility of, and thus interoperability among, functional-area Data Dictionaries and the Registry.

The Registry should include among its meta attribute configuration items all meta attributes, including any extensions therein that are approved by the CCC for inclusion in the Registry.

A.5.5 Controlling configuration items

A.5.5.1 Baselines

Change control of the ITS/TICS Registry and (optionally) ITS/TICS functional-area Data Dictionaries is achieved by controlling changes to configuration items and sets of configuration items established as baselines. Such control is exercised by the CCC. Proposals for configuration item changes must be submitted to the Registrar in time sufficient to prepare a baseline.

A.5.5.2 Configuration item baseline

Baselines are maintained for meta attribute data concepts only. Other ITS/TICS DR data concepts are not baselined.

A “Current Baseline” and a “Development Baseline” are established and maintained for meta attributes of the ITS/TICS Registry and (optionally) ITS/TICS functional-area Data Dictionaries. The Registry and (optionally) ITS/TICS functional-area Data Dictionaries should operate on the Current Baseline and synchronously implement the Development Baseline as a new Current Baseline when the Development Baseline approved by the CCC as the new Current Baseline.

The CCC controls the release of each Development Baseline as the new Current Baseline for both ITS/TICS Registry meta attributes and (optionally) ITS/TICS functional-area Data Dictionary meta attributes.

A.5.5.3 Configuration item change control

Changes or additions to meta attribute configuration items are requested in accordance with the following procedures:

a) Stewards and the Registrar collect, evaluate, and document requests for meta attribute configuration item changes or additions, including changes to the standard values of the meta attributes under controlled word list control such as Keyword, Data Concept Type, and Relationship Type.

b) Stewards forward such documented requests to the Registrar along with a recommendation as to the merits of each proposal.

c) The Registrar presents such proposals to the CCC, along with a recommendation on the disposition of each proposal.

d) The CCC decides the disposition of each proposal.

e) The Registrar notifies the functional-area Stewards of the disposition of each proposal.

A.5.6 Reporting configuration status

The Registrar records and reports to the CCC the current status of meta attribute configuration item baselines and ITS/TICS data concept change requests at least semi-annually in their face-to-face meetings, or in their interim electronic meetings if so directed.

A.5.7 Auditing configuration items

The Registrar is responsible for audits of meta attribute Current Baseline. In implementation of this responsibility, the Registrar will periodically accomplish the following at least annually:

a) Evaluate the Registry's meta attributes against the meta attribute Current Baseline configuration items.

b) Optionally, evaluate each functional-area Data Dictionary meta attribute against the meta attribute Current Baseline configuration items.

The Registrar should provide a report to the CCC of the results of all such evaluations, together with recommended corrective actions, if appropriate.

A.6 ITS/TICS data harmonization and reuse procedures

A.6.1 Introduction

These procedures detail how the CCC and the Stewards execute their responsibilities as identified in A.2 regarding identification, reconciliation, and documentation of data concept overlaps and duplications across Stewards' cognizant areas (and reuse of data concepts among Stewards' cognizant areas). See Figure A.5.

Eventually the ITS/TICS Registry will contain the following data concepts: Interface dialogues, data elements, messages, and data frames, as well as data element concepts, object classes, properties, value domains, and associations. Each data concept will be described by meta attributes.

Initially, the ITS/TICS Registry is expected to contain only data elements; however, its contents may be expanded to include other data concepts, as noted above.

The Stewards and Data Registry Manager shall bring to the attention of the ITS/TICS CCC instances where it appears that duplications of data concepts have been proposed.

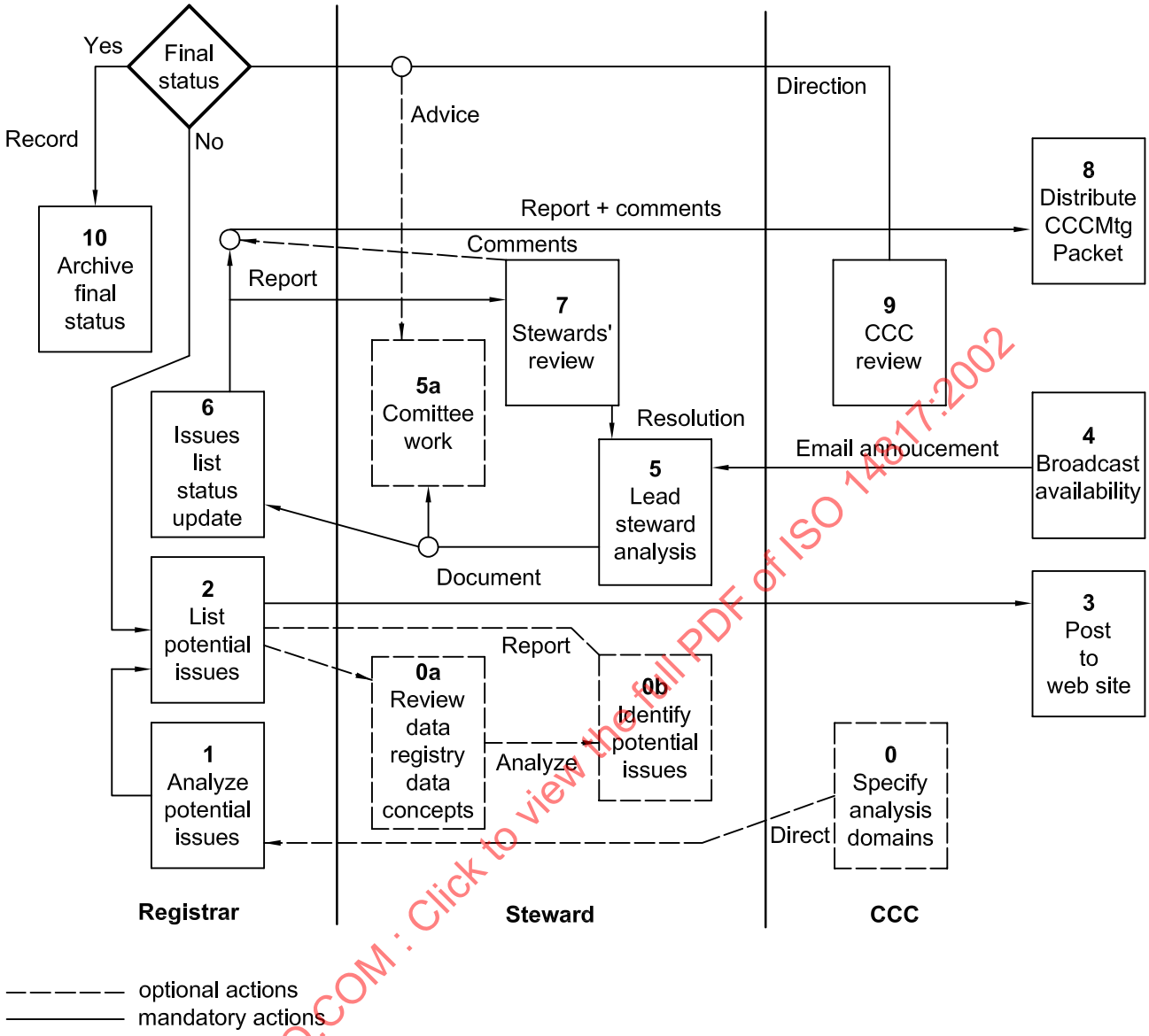


Figure A.5 — Harmonization procedure flow

A.6.2 Identification and Resolution of ITS/TICS Data Issues

Procedures for identification and resolution of ITS/TICS data concept issues will begin with a Steward's data elements. As the ITS/TICS Registry is populated with other data concepts, harmonization of these data concepts can be addressed.

Identification of potential data concept issues may be accomplished by Stewards, the Registrar, or as specifically focused by CCC directives, as follows:

Step 0: The CCC may further direct the Registrar to focus analysis efforts within particular domain areas (e.g., location reference or incident management) or data concept (e.g., value domains).

Step 0a: Stewards may review the Registry contents for potential data concept issues.

Step 0b: Stewards report any potential data concept issues to the Registrar, specifying the data concept identifiers of the data concepts of concern.

Step 1: The Registrar will use the capabilities of the Registry to identify potential overlapping or redundant data concepts. Identification of potential data concept issues will result from analysis by the Registrar of data element names, definitions, common property/object/representation terms, and common or similar value domains.

Step 2: The Registrar will prepare a summary listing of potential data concept issues together with all documenting meta attributes for each data concept on the summary listing. See Table A.1 for an example listing. The listing will contain any new potential data element issues identified since the last check pointed version as well as any open data element issues from past months--including the latest harmonization status for previously identified data element issues. This summary listing will include the following meta attributes: Data Concept Identifier, Steward's Identifier (if any), Descriptive Name, Definition, Value domain term, Remarks (wherein harmonization status remarks are maintained), and View (wherein the Steward(s) associated with the data element issue is (are) identified). The listing will identify the lead Steward (by underlining one of the Stewards in the "View" meta attribute) that is expected to lead the resolution efforts as well as any Steward(s) associated with the potential data element issue. Note that there may be occasions wherein there is no "lead Steward" identified, if it proves useful to have a third party take the lead on the issue. Note, also, that the lead Steward may be changed with the consent of all other Stewards involved in the data issue at hand by notification to the Registrar of the agreed upon new lead Steward.

Step 3: The Registrar will post the listing to the ITS/TICS Data Registry web site.

Step 4: The ITS/TICS Data Registry Secretary will announce availability of the issues listing via email to the Stewards and other CCC members.

Step 5: Upon receipt of this periodic listing, each lead Steward will analyse the potential data element issues in their listing, consulting with any other Steward(s) associated with the data element at issue (as appropriate), and determine an appropriate resolution of the data element issue. The first step in this process is for each of the Stewards involved in a set of data concepts at issue to understand the semantics of the data concepts at issue. If the semantics are not equivalent then the data concepts should remain separate. If they are equivalent or significantly equivalent, then the Stewards should agree to use one of them, modify one of them for joint use, or mutually agree to a new data concept to supersede those data concepts at issue. After achieving semantic resolutions, the Stewards then should address the Value Domain (if appropriate) of the data concepts at issue. The intent of this examination is to agree on a mutual solution to these dimensions of the data concepts at issue.

Resolution may be that one data concept is selected and other data concepts reference the selected data concept as superseding, the data concepts at issue are merged into a new data element and the other data concepts at issue reference the new data concept as superseding, or the data concepts at issue are kept separate and independent.

Each lead Steward may report to the Registrar the status of data element resolutions as soon as that resolution is determined, including any interim resolution status (such as how the resolution will be determined or inability to achieve resolution). This report will be accomplished by electronically returning only the entries that have been changed in the summary listing to the Registrar with a resolution status note inserted in the Remarks column for each data concept. The resolution status note will refer to the Data Concept Identifier of each data concept at issue and state the harmonization status associated with that data concept. It will also state the effective date of the harmonization status. These notes will be placed in the beginning of the remarks section of the listing for each data element at issue. Each lead DD Steward will make such a report to the Registrar incrementally as issues are resolved or by the end of the third month of each quarter as a minimum.

Step 5a: Each Steward associated with the data issue resolution at hand is responsible for obtaining appropriate approval of their standards committee(s) (in accordance with their own internal procedures) for data element issue resolutions that require any changes or additions to their Steward's data elements. Interim resolution statuses are anticipated while the Stewards work with their own particular standards committees, if any.

Step 6: Two weeks before any CCC meeting, the Registrar will distribute a summary listing of all data concepts at potential issue together with the current resolution status for each data concept and a complete statement of all meta attributes for each data concept at issue. This listing will be electronically distributed to all Stewards.

Step 7: Stewards may report any issues they have with this listing to the ITS/TICS Registrar by one week before the CCC meeting in order that a complete packet can be prepared for the CCC meeting reflecting the most current status of harmonization issues. The Registrar will forward the master listing and any remarks received from the Stewards to the ITS/TICS CCC Secretary by one week before the CCC meeting.

Step 8: The ITS/TICS CCC Secretary will distribute the harmonization listing to the CCC members.

Step 9: The CCC will review the harmonization results and issue directions to the Registrar. For those data concepts at issue for which harmonization has been achieved between the relevant Stewards, the CCC will review and approve the Stewards' harmonization status, or require such additional harmonization actions as may be appropriate. The CCC will review those data concepts at issue that the relevant Stewards have not been able to resolve and propose resolutions, if possible. The Registrar should retain each data concept at issue, together with its current harmonization status, on the harmonization listing until such time as final resolution is accomplished, appropriate standards committees have approved of the resolution, and the CCC has approved the final harmonization status. These data concepts will be included in the next listing of harmonization issued at Step 2.

Step 10: Data elements having such final harmonization approval will be removed from the harmonization listing and retained in an archive file as a permanent record of the issue resolution. The Registrar will ensure that all harmonization statuses for all data concepts at issue are posted to the appropriate data concepts in the ITS/TICS Registry.

Table A.1 — Example harmonization summarization listing

Data concept identifier	DD Identifier	Descriptive name	Definition	Value domain term	Remarks	View
15		CPT_DayofWeek_ cd	A day of the week	code	Char format; ADUS to be the same. Dave to provide transform to/from 479	Transit
479	15	ATIS_DayOfWeek_ code	Describes the Day of the Week, including a Holiday option	code	Bit map format; NTCIP to be the same. Dave to provide transform to/from 15	Traveler Information
49		CPT_PTVehicleID_ nbr	A unique number assigned by the transit agency to each of their vehicles	number	TCIP to consider collapsing with 350; code as RCT?	Transit
350		IM_ResponseUnit ID_nbr	Identification number of a vehicle (transit or non-transit)	number	TCIP to consider collapsing with 49; code as RCT?	Transit
504	205	VEHICLE_Identity_ number	Identity of vehicle	number	ATIS to include "VIN" in definition; code as RCT	Traveler Information
3274	3274	ORGANIZATION. RESOURCE_ Vehicle_identifier	A unique identifiers of an organization's vehicle associated with a roadway event.	identifier		Traffic Manage-ment

A.6.3 Reuse of ITS/TICS Data Concepts

Reuse of ITS/TICS Data Concepts, will be occasioned by one of three situations:

1) Reuse will result from the agreement among a number of Stewards that a particular data element (or other data concept) is the superseding data element (or concept) for their purposes [and appropriate standards committee actions are engaged by the appropriate Steward(s) to accomplish this result].

2) A standards committee is looking for an existing data concept to reuse in their own environment.

3) An application system developer, or other third party (state, city, etc.), may identify potential data issues.

In the first case, agreement among the affected Stewards requires that whomever may be involved in a particular harmonization accomplish the necessary procedural matters to effect the resolution as to reuse of the data element or other data concept within their associated standards committee environments.

In the second case, Stewards should review the Registry for possible data concepts to reuse in their domain. Stewards may access the ITS/TICS Data Registry to search for potential reusable data concepts, requesting the assistance, if appropriate, of the Registrar.

In the third case, a developer or other third party should review the contents of the Registry to identify potential data for reuse, requesting the assistance of the Registrar, if desired.

Annex B
(normative)

Contents of the ITS/TICS Data Registry and ITS/TICS Data Dictionaries: Meta attribute definitions

B.1 Introduction

The definitions for the meta attributes of the ITS/TICS Data Registry and ITS/TICS Data Dictionaries are given in this annex. Meta attributes in the identification category shall serve to identify data concepts from a number of perspectives, e.g., a unique data concept identifier, a unique ASN.1 name, a unique descriptive name, a URL. Meta attributes in the definitional category shall provide definitional information about a data concept. Relational meta attributes shall define relationships among data concepts. Representational meta attributes shall document the representation aspects of data concepts. Administrative meta attributes shall be used to present administrative information relating to data concepts.

See Annex C (Contents of the ITS/TICS Data Registry and ITS/TICS Data Dictionaries: Meta attribute requirements for data concepts) for requirements relating meta attributes to data concepts.

The names for the meta attributes defined in this annex are specific to the meta attribute definitions defined herein and are to be so defined solely within the context of Annex B and the related Annex C. The general use of such terms (e.g. Remarks) throughout the rest of the Standard is the common, less specific usage of the word.

The proposal and adoption of meta attribute definitions shall be a managed process. The Stewards and Data Registry Registrar shall bring to the attention of the ITS/TICS CCC instances where it appears that duplications of data concepts have been proposed.

NOTE These basic meta attributes may be represented in one or more (meta) data models to reflect more completely the relationships among the data. While selected meta attributes are based upon ASN.1 syntax for data representation, alternative (meta) data models may result in alternative syntax. Consequently, additional meta attributes to support other syntaxes (e.g. CORBA IDL, EDIFACT, XML Schema) may be added in future revisions and some existing mandatory attributes may become optional.

B.2 Identification meta attributes

B.2.1 Data concept identifier

Definition: An unambiguous unique identifier allocated, by the Registrar, to every data concept. For the ITS/TICS Data Registry, the Data Concept Identifier (DCI) shall be a INTEGER UNIQUE in accordance with ASN.1 specification depending on the Registrar. Alpha/alphanumeric/ASCII character strings shall not be acceptable.

Description: The value of this meta-attribute is automatically assigned for data concepts entered into the ITS/TICS Data Registry.

B.2.2 Data concept version

Definition: An integer reference to a revision or refinement of a data concept that does not change its semantic content, or, if appropriate, its representational form.

Description: Versions are established to record minor, non-semantic/representational changes to a data concept. Changes in the administrative meta attributes do not result in a version change. The value of this meta-attribute is automatically assigned for data concepts entered into the ITS/TICS Data Registry.

B.2.3 Descriptive name

Definition: A descriptive word or group of words that labels a data concept. Descriptive names shall be constructed in accordance with requirements of Clause 9.

Description: Descriptive names represent the meaning of the data concept and facilitate semantic understanding.

B.2.4 Synonymous descriptive names

Definition: Names assigned to a data concept that differ from its descriptive name, but represents the same data concept.

Description: The type of data concept specifies what “same” means. At a minimum, the data concepts must be semantically equivalent. For instance, two data element concepts may have differently worded definitions; but, if they are equivalent semantically, their names are synonymous. Data elements, on the other hand, must not only be semantically equivalent but they also must have identical value domains. For instance, two data elements representing a date as “Gregorian date” and “Julian date” are two different, but related, data elements. Synonymous descriptive names do not need to conform to the naming conventions in Clause 9.

NOTE Synonymous descriptive names should be introduced only where necessary. They may be of use, for instance, when the contents of several functional-area Data Dictionaries are synthesized into the ITS/TICS Data Registry, and the same data element (from the perspective of its semantics and value domains) occurs in more than one functional-area Data Dictionary, but with different descriptive names. It may be useful to choose one of these names (or a “neutral” name) as the primary descriptive name, and to show one or more of the other names as synonymous descriptive name(s).

B.2.5 Symbolic names

Definition: The names for a data concept as used in application programs.

B.2.6 ASN.1 name

Definition: The ASN.1 Name shall be the name of a data concept expressed as a valid “typereference” as defined in 11.2 of ISO/IEC 8824-1:1999. The ASN.1 name should be unique within the ITS/TICS community.

Description: The name of a data concept expressed in ASN.1 syntax.

NOTE Information on ASN.1 naming conventions and conversion from ITS/TICS Data Dictionary data element names to ASN.1 names can be found in Annex D.

B.2.7 ASN.1 object identifier

Definition: A unique ASN.1 object identifier in accordance with ISO/IEC 8824-1.

Description: An OID that shall be assigned once to each specified data concept.

B.2.8 Uniform resource locator

Definition: A Uniform Resource Locator (URL) is a representation of the location and access method for a resource available via the Internet.

Description: If data concept, which is subjected by URL, is not included in ITS/TICS Data Registry and/or Data Dictionary, the URL indicates location and access method of the data concept.

B.3 Definitional meta attributes

B.3.1 Definition

Definition: A statement in natural-language text that expresses the essential meaning of a data concept and assists humans in differentiating the data concept from all other data concepts.

B.3.2 Descriptive name context

Definition: A designation of the ITS/TICS functional area within which the descriptive name is relevant.

Description: Legal values for this meta attribute are the names of the functional areas (subsystems) for the ITS/TICS architecture. Multiple descriptive name contexts are allowed.

B.3.3 Symbolic name usage

Definition: The name(s) of the application(s) within which the data element symbolic name is used.

B.3.4 Source

Definition: The source document or other reference that was used to develop the pertinent data concept.

Description: The source is a reference to the original document (e.g., white paper, architecture or standard) that defines the requirement for the data concept. For value domains the source shall be the standard that describes the concept (e.g. for most measurements the source is ISO 1000).

B.3.5 Architecture reference

Definition: The name of one or more ITS/TICS Architecture “architecture flow”(s) with corresponding architecture source (subsystem or terminator) and architecture destination (subsystem or terminator) into which this data concept can be meaningfully categorized wholly or in part.

Description: For classification of data concepts, the legal values for Architecture Reference shall be the architecture flow names with corresponding source and destination given in a framework ITS/TICS Architecture, for example a published version of the *ITS/TICS Reference Architecture*.

In use for example, in a Data Registry data concept entry screen, the triple of architecture flow name, source name and destination name should be selected from a valid value list derived from the specified version of the framework ITS architecture. The list should be optionally sorted (as selected by the Data Steward or Submitter): source, destination, architecture flow name; or destination, source, architecture flow name; or architecture flow name, source, destination; or architecture flow name, destination, source.

Other schemes may be used in addition to this classification scheme (for instance, there might be another classification scheme based on treating the data concepts as objects in a communications context). For each Architecture Reference there shall be an Architecture Name and an Architecture Version for classification of the data concept to be complete.

B.3.6 Architecture name

Definition: The designator (e.g., the title or number) of an ITS/TICS or other Architecture that contains the Architecture reference(s).

B.3.7 Architecture version

Definition: The version number of an ITS/TICS or other Architecture that contains the Architecture reference(s).

B.3.8 Data concept type

Definition: A categorization of the kind of data concept.

Description: Legal values for data concept type are:

a) Object class

b) Property

c) Value domain

d) Data element concept

e) Data element

f) Data frame

g) Message

h) Interface dialogue

i) Association

B.3.9 Remarks

Definition: Comments or other information pertinent to the data concept.

Description: This meta attribute is unconstrained as to its textual content.

B.3.10 Context

Definition: Particular circumstances surrounding the data concept.

B.3.11 Standard

Definition: The alphanumeric designation of the standard, or other reference, that defines and describes the data concept. Acronyms or identifiers may be used.

Description: The standard will nominally be the functional Data Dictionary standard that defines the data concept

B.3.12 Metadata source

Definition: Indicates where the metadata resides that is used to describe and interpret the data concepts, the values of which comprise the Data Concept Instance data in the message.

The default source shall be “direct,” which assumes the receiving system knows what all the data being sent means, based on the data elements all being specified in an ITS/TICS Data Dictionary and/or the ITS/TICS Data Registry.

“Indirect” means instances of the message contain data corresponding to at least some data elements not “directly” known to the receiving system, but which are specified in other (external to ISO/TC 204) systems in an compatible format. In this case, in the message specification the source of the metadata shall be specified for any data element not found in the ITS/TICS Data Dictionary and/or the ITS/TICS Data Registry. This shall be specified as a reference to some foreign source (for example, a Data Dictionary or registry that is not within the ITS/TICS community).

"Embedded" means that the message instances include, as part of their message, the metadata for any data elements which are not found in an ITS/TICS functional-area Data Dictionary and/or the ITS/TICS Data Registry, or which are not indirectly referenced in some foreign source. In this case, the metadata shall be specified in the message specification, if known at the time the specification is produced. In cases where the metadata is not known in advance (i.e., ad hoc messages, where the data and its metadata cannot be determined until the message instance is created), a placeholder ("embedded") shall be specified for such data. The message instance must then contain an embedded specification of its data elements. How this is accomplished varies by message implementation environment, for example, a self-describing data system.

Description: The value of this meta attribute shall be specified as "direct/indirect/embedded," with reference data or embedded metadata being specified, as appropriate.

EXAMPLE Direct

B.3.13 Priority

Definition: Indicates whether or not a message should receive priority treatment. If applicable, the priority scheme and/or the priority of the message may be specified.

NOTE 1 There may be one global ITS/TICS priority scheme applicable to all ITS/TICS "broadcast" messages. There may be others specific to particular messages or message groups. Knowledge of such schemes should be taken into account during message specification.

NOTE 2 Wireless messages might be good candidates for a "round robin" priority scheme whereby important messages are transmitted every time, and less important messages as time permits. The priority scheme in this case would be two-valued: urgent versus as time permits.

Description: Specify priority/no priority. If "priority," this meta attribute may also be used to specify the priority scheme and/or the priority of the message. Default is no priority.

EXAMPLE

— Priority, urgent versus as time permits

— Priority, urgent/normal/low

— Priority, 1-10 (10 highest priority)

— No priority

B.3.14 Frequency/message mode

Definition: Indicates the expected timing or rate of occurrence of an instance of this message. Additionally, indicates the message mode for periodic messages.

Description: Indicates whether a message instance is "periodic/event driven/user driven." If periodic guidance may be provided by the message developers as to the frequency or range of frequencies. Multiple selections is allowed, for example "periodic and event driven."

EXAMPLE

— Periodic, 20 seconds

— Event driven

— User driven

B.3.15 Delivery verification

Definition: Indicates whether instances of this message shall/may require that delivery to the intended recipient be confirmed. May include retry criteria.

Description: If used, specify, “shall” or “may.” The message developers should provide guidance to the implementer as to how this meta attribute is to be used.

EXAMPLE

— Shall, critical for financial transactions, retry for four hours.

— Shall, attempt delivery while “Traffic_incident” is true.

B.3.16 Data quality

Definition: Indicates that data should have a data quality description.

Description: This meta attribute shall be used to specify the details of data quality for a data element. Multiple items may be required to describe data quality, with some items being qualitative (e.g., free text) and others quantitative. These items should be clearly defined so that data users can determine whether the data in question are of the required quality for the intended purpose.

EXAMPLE (for measured data such as sensor outputs)

— Performance in the time domain: measurement timing or cycle.

— Accuracy: number of significant digits, rate of error, or range of measurement.

— Data generation method: method of measurement, including instrument name.

— Reliability: Levels 1/2/3, where Level 1 indicates that data loss is not allowed at all, and that the data are used by services that have a heavy responsibility such as lifesaving; Level 2 indicates that lost data should be compensated appropriately, although some data loss is allowed; Level 3 indicates that some data loss is allowed.

B.4 Relational meta attributes

B.4.1 Modeling-related meta attributes

The first three relational meta attributes (Precursor, Successor, Synonym) are introduced to identify certain stereotype association relationships (extensions in the vocabulary of the UML) that operate at the meta level, i.e. they are used to define associations between data concepts, not between their instantiations. Any relationship may be described by the other meta attributes defined here. Refer to Figure B.1 for UML representation of among selected data concepts.

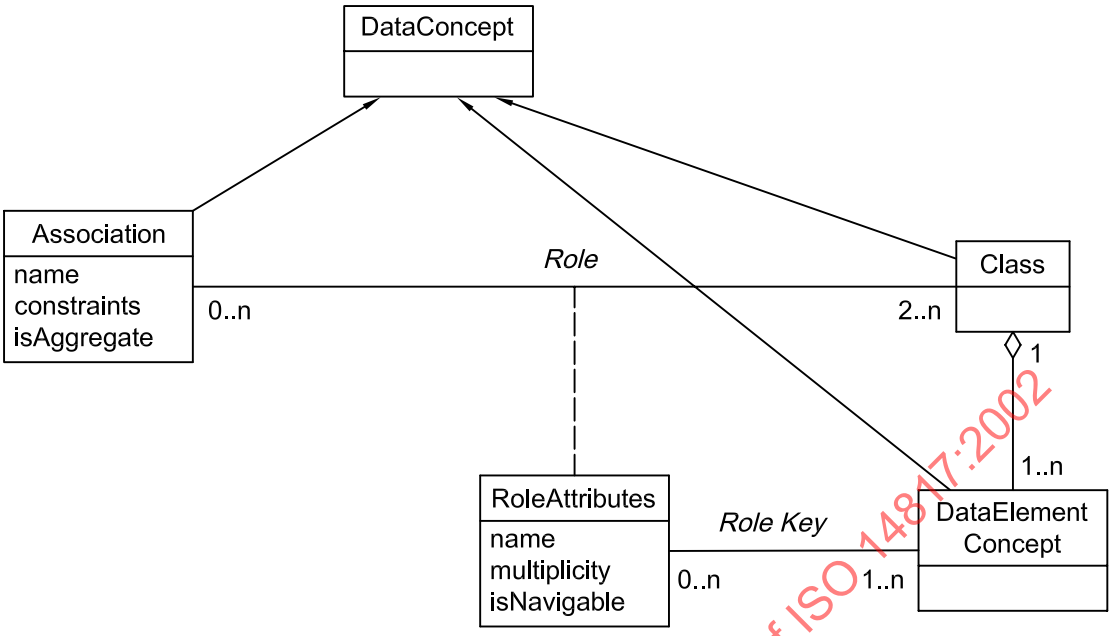


Figure B.1 — Meta attribute relationships

B.4.2 Precursor

Definition: A historical, semantically similar data concept, which this data concept has replaced or is replacing.

Description: Multiples allowed. Applies to all data concepts. This shall be the Descriptive Name of the data concept that has been replaced.

B.4.3 Successor

Definition: A newer, semantically similar data concept, which has replaced or is replacing this data concept.

Description: Multiples allowed. Applies to all data concepts. This shall be the Descriptive Name of the data concept that has replaced the data concept to which this meta-attribute applies.

B.4.4 Synonym

Definition: A semantically similar data concept

Description: Multiples Allowed. Applies to all data concepts. This shall be the Descriptive Name of the synonymous data concept.

B.4.5 Abstract

Definition: An indication (true or false) of whether the object class has member objects. Abstract object classes cannot be instantiated, but they may have non-abstract specializations.

Description. This meta attribute only applies to object classes. Must be defined once for each object class.

B.4.6 Roles

Definition: Identifies the object classes in an association and the “face name” that each object class presents to the other object classes(s) involved in the association.

Description: “<object class[1] name>”,“<role[1] name>”, “<object class[2] name>”,“<role[2] name>”, ….

In the case of a generalization relationship, <role[1] name> = parent, <role[2] name> = child.

Applies only to the association data concept.

B.4.7 Multiplicity

Definition: The number of instances of the subject data concept that are associated with a given data concept

Description: A specification of the range of all allowable cardinalities a data concept may assume. Applies to object class and association.

B.4.8 Association Constraints

Definition: The constraints meta attribute identifies any special constraints placed on an association. These constraints include the following terms as defined in UML, and may consist of other terms deemed appropriate.

implicit - relationship is only conceptual

ordered - set of objects at one end of association are in an explicit order

changeable - links may be added, removed, and changed

addOnly - new links may be added from an object on the opposite end of the association

frozen - link may not be modified or deleted

xor - exactly one set for each associated object class

Description: Applies only to the association data concept.

B.4.9 Aggregate

Definition: Indicates whether the object class designates a “whole” in a “whole-part” association. If the value is false, the association is not a whole-part.

Description: A simple true or false. Applies only to the association data concept

NOTE Aggregation is a special kind of association in which one object class represents a larger thing (the “whole”) which consists of smaller things (the “parts”).

B.4.10 Role Key

Definition: The mechanism by which the role player object class in an association is identified as a specific instance of the subject object class.

Description: Shall be specified if the role is navigable. An ordered list of data elements defined the object class of the association. Applies only to the association data concept.

NOTE A role is the face that an object class presents to an object class at the other end of an association.

B.4.11 Referenced messages

Definition: A set of messages which are employed in an interface dialogue.

Description: The messages shall be identified by using the ASN.1 object ID meta attribute for the related messages. Applies only to the interface dialogue data concept. Multiples allowed.

NOTE When ASN.1 encoding rules are applied, there is a guarantee that values of a message will be unambiguously transferred. When an interface dialogue needs to use a set of messages, unambiguity can be preserved by defining a single message which is a “CHOICE” of the messages in the set.

B.4.12 Referenced data frames

Definition: A set of data frames which are involved in elaborating other data concepts such as information dialogue and messages. Multiples allowed.

Description: The data frames shall be identified by using their ASN.1 object ID meta attribute.

B.4.13 Referenced data elements

Definition: A set of data elements which are involved in elaborating other data concepts such as data frame or message.

Description: The data elements shall be identified by using their ASN.1 object ID meta attribute. Multiples allowed.

B.4.14 Referenced object classes

Definition: A set of object classes which are involved in elaborating other data concepts such as associations.

Description: The object classes shall be identified by using the ASN.1 object ID meta attribute. Multiples allowed.

B.4.15 Referenced associations

Definition: A set of associations which are involved in elaborating an interface dialogue.

Description: The associations shall be identified by using their ASN.1 object ID meta attributes. Multiples allowed.

B.5 Representational meta attributes

B.5.1 Data type

Definition: The logical representation of the data concept as expressed as a valid data concept instance of an ASN.1 data type.

Description: The form of this meta attribute for messages, data frames, data elements and value domains is specified in the following sub-clauses.

B.5.1.1 Description for messages

The text of this meta-attribute shall consist of a complete and syntactically correct ASN.1 module definition. The module identifier for this module is provided by the definer of the module, and is not the same as the ASN.1 Object Identifier meta-attribute that identifies the registration entry. The module definition may contain IMPORT statements, but these shall reference only modules defined in the Data Registry as either data

elements or as data frames. It may contain multiple ASN.1 type definitions. The first type definition defines the message and shall be exported. Any other type definitions shall not be exported, and shall be referenced (directly or indirectly) by that first type definition. Within each type definition, only imported type references and the ASN.1 constructors “SEQUENCE”, “SEQUENCE OF” and “CHOICE” shall be used.

The contents of a message shall be specified by elaborating which data elements (including data frames composed of groups of data elements, and in some cases, other data concept types) are grouped or packaged into which messages, under what conditions and, where applicable, in what order. The instantiation of these data elements shall comprise the actual message for a message instance. The specifications shall be expressed in ASN.1 syntax as per ISO/IEC 8824-1 and ISO/IEC 8824-2. The specifications shall use only the data elements, data frames composed of data elements and in specifically predetermined cases other data concept types, specified in ITS/TICS Data Dictionaries. Exceptions are made for data elements found in external Data Dictionaries (handled indirectly, by reference), as well as those cases where metadata is embedded in the instance of the message (handled by noting that there will be embedded metadata).

Message specifications should use only data elements (which are low-level data concepts considered atomic in some context for some purpose) and data frames. However, more complex data structures can be specified in a message by building up groups of data elements using ASN.1 constructors. Commonly occurring sequences or other groupings of data elements may be handled through the use of the “data frame” data concept.

The packaging or grouping of data concepts (data elements, data frames, and/or other data concept types) into messages may involve specifying any or all of the following:

— The data concepts comprising the message, including their ordering or sequence, where applicable

— Repeatability of data concepts within a sequence, or of segments of sequences, comprising the message

— Optionally, default values and conditionality (i.e. dependency) among data concepts comprising the message.

Repeating sequences of data concepts are allowed as part of a message specification.

B.5.1.2 Description for data frames

The text of this meta-attribute shall consist of a complete and syntactically correct ASN.1 module definition. The module identifier for this module is provided by the definer of the module, and is not the same as the ASN.1 Object Identifier meta-attribute that identifies the registration entry. The module definition may contain IMPORT statements, but these shall reference only modules defined in the Data Registry as either data elements or as data frames. It shall contain a single ASN.1 type definition. This type definition defines the data frame and shall be exported. Within that type definition, only imported type references and the ASN.1 constructors “SEQUENCE”, “SEQUENCE OF” and “CHOICE” shall be used.

B.5.1.3 Description for data elements

The text of this meta-attribute shall consist of a complete and syntactically correct ASN.1 module definition. The module identifier for this module is provided by the definer of the module, and is not the same as the ASN.1 Object Identifier meta-attribute that identifies the registration entry. The module definition may contain IMPORT statements, but these shall reference only modules defined in the Data Registry as value domains. The module shall contain a single ASN.1 type definition. This type definition defines the data element and shall be exported. Within that type definition, only the ASN.1 constructors “SEQUENCE”, “SEQUENCE OF” and “CHOICE” shall be used, together with the “base ASN.1 types” defined below, possibly with a constraint applied to them or to uses of the “SEQUENCE OF” construction.

Within this context, the term “base ASN.1 type” shall mean one of the following data types, which are a subset of the ASN.1 types specified in ISO/IEC 8824-1. The data types are listed here with the formal definitions given in ISO/IEC 8824-1.

NOTE The following notation conforms to the rules as specified in ISO/IEC 8824-1:1998, Clause 5.

```
ITS-DD-Type ::=
ITS-DD-BuiltinType     |
ITS-DD-ReferencedType  |
ITS-DD-ConstrainedType

ITS-DD-BuiltinType ::=
BooleanType                | -- see ISO/IEC 8824-1, Clause 17
IntegerType                | -- see ISO/IEC 8824-1, Clause 18
EnumeratedType             | -- see ISO/IEC 8824-1, Clause 19
RealType                   | -- see ISO/IEC 8824-1, Clause 20
BitStringType              | -- see ISO/IEC 8824-1, Clause 21
OctetStringType            | -- see ISO/IEC 8824-1, Clause 22
NullType                   | -- see ISO/IEC 8824-1, Clause 23
TaggedType                 | -- see ISO/IEC 8824-1, Clause 30
ObjectIdentifierType       | -- see ISO/IEC 8824-1, Clause 31
BMPString                  | -- see ISO/IEC 8824-1, Clause 36
IA5String                  | -- see ISO/IEC 8824-1, Clause 36
NumericString              | -- see ISO/IEC 8824-1, Clause 36
UTF8String                   -- see ISO/IEC 8824-1, Clause 36

ITS-DD-ReferencedType ::=
typereference              | -- see ISO/IEC 8824-1, Clause 11.2
Externaltypereference      | -- see ISO/IEC 8824-1, Clause 13.4
GeneralizedTime            | -- see ISO/IEC 8824-1, Clause 41
ObjectDescriptor             -- see ISO/IEC 8824-1, Clause 43

ITS-DD-ConstrainedType ::=
ITS-DD-Type Constraint       -- see ISO/IEC 8824-1, Clause 44.5
                             -- for definition of constraint
```

If the Type is a “typereference” or “Externaltypereference,” the typereference shall be the ASN.1 Name of a defined Reference value domain.

Fixed point decimal may be represented by an integer type if the definition meta attribute indicates the offset of the decimal.

Floating point decimal may be derived from real type.

UTF8String shall be used for the character string type in the case of international information exchange. BMPString and IA5String may be used in regional/country Data Registry/Data Dictionary.

BMPString type and IA5String type are subsets of UTF8String type. Use of constraints to restrict the alphabets of BMPString (for Unicode) and IA5String (for ASCII) may result in more efficient encoding than use of UTF8String, while if no constraint is present UTF8String may result in more efficient encoding than BMPString.

Permissible ranges of values, lists of values for enumerated types, or rules for determining valid values for the value domains of data elements shall be specified for the data elements as part of the metadata about them in an ITS/TICS functional-area Data Dictionary and/or the ITS/TICS Data Registry as well as being present in the ASN.1 module definition.

Data types and size-related constraints shall be specified for the data elements as part of the metadata about them in an ITS/TICS functional-area Data Dictionary and/or the ITS/TICS Data Registry. Placing limits on the size of integers, the length of strings, and the number of iterations in a SEQUENCE OF, typically with an extension marker to allow for expansion in a later version, are likely to result in more efficient bits-on-the-line.

Any metadata related to data elements in a message specification that is in addition to the information in an ITS/TICS functional-area Data Dictionary and/or the ITS/TICS Data Registry should be maintained in coordination with the Data Dictionary and/or registry to ensure consistency.

NOTE Submitters of version 1 ASN.1 definitions are strongly encouraged to provide extension markers where appropriate. For example, in an element “vehicle-type ENUMERATED {unknown, car, heavy-goods-vehicle, public-service-vehicle, ...} the ellipsis should certainly be included to indicate possible additions in version 2.

B.5.1.4 Description for value domains

The text of this meta-attribute shall consist of a complete and syntactically correct ASN.1 module definition. The module identifier for this module is provided by the definer of the module, and is not the same as the ASN.1 Module Identifier meta-attribute that identifies the registration entry. The module definition shall not contain an IMPORT statement. The module shall contain a single ASN.1 type definition. This type definition defines the value domain and shall be exported. Within that type definition, only the ASN.1 constructors "SEQUENCE", "SEQUENCE OF" and "CHOICE" shall be used, together with the "base ASN.1 types" defined in B.5.1.3, possibly with a constraint applied to them or to uses of the "SEQUENCE OF" construction.

The definition of a value domain differs from the definition of a data element only in that the semantics associated with the different values may be absent, and provided when the value domain is used in the definition of a data element.

B.5.2 Format

Definition: A natural language description of the logical layout of the data concept in relation to interchange of data. The format meta attribute shall not be interpreted to override the restrictions in either the data type or valid value rule meta attribute.

Description: The specific layout depends upon the data type of the value domain.

B.5.3 Unit of measure

Definition: Units shall be defined in accordance with ISO 1000. For units of enumeration, such as equipment or units of issue the standard measure shall be defined using this meta attribute.

Description: Indicates the appropriate measurement framework (i.e., approved names for standard measures of extent, quantity, amount, distance, dimensions, capacity, etc.) for the measurement numbers associated with a data concept.

B.5.4 Valid value rule

Definition: A natural language text definition of the rule(s) by which permissible legal instances of a data element or a value domain are identified. In no case shall the valid Value Rule allow values that are not in accordance with the Data Type meta attribute.

Description: While the precise abstract data exchange format is defined by the Data Type meta attribute, a valid value rule may be used to further constrain valid values (e.g., due to relationships to other data concepts) or to provide a natural language text definition of the data format.

B.6 Administrative meta attributes

B.6.1 Registration status

Definition: An administrative or qualitative level assigned to a data concept according to its status in a qualitative hierarchy (or interim administrative status in between qualitative levels).

Description: Legal values for the qualitative registration status levels are Card, Draft, Recorded, Qualified, and Preferred.. Legal values for the administrative registration status levels are Provisionally Qualified, Provisionally Preferred and Retired.

B.6.2 Date registered

Definition: The date that a data concept is initially entered into the ITS/TICS Data Registry, regardless of its registration status at the time it was entered.

Description: The value of this meta attribute is assigned automatically by the ITS/TICS Data Registry.

B.6.3 Last change date

Definition: The date that the last version of the data concept was recorded in the ITS/TICS Data Registry.

Description: The value of this meta attribute is assigned automatically by the ITS/TICS Data Registry.

B.6.4 Last change user

Definition: The access name of the person who made the last change to the data concept.

Description: The value of this meta attribute is assigned automatically by the ITS/TICS Data Registry.

B.6.5 Registrar organization name

Definition: The reference to the authority under which the data concept was registered.

Description: When a functional-area Data Dictionary reuses a data concept from a foreign Data Dictionary, the source authority for the external data concept is recorded in this meta attribute, otherwise the ITS/TICS registration authority is recorded.

B.6.6 Registrar phone number

Definition: The telephone number [country code, city code, area code, exchange number, telephone number, extension number] of the authorized registrar.

Description: When a functional-area Data Dictionary reuses a data concept from a foreign Data Dictionary, the source authority for the foreign data concept is recorded in this meta attribute, otherwise the ITS/TICS registration authority is recorded.

B.6.7 Steward organization name

Definition: A reference to the authority having responsibility for a data concept.

Description: This is the organization assigned responsibility for managing data concepts within a defined data subject area.

B.6.8 Steward phone number

Definition: The telephone number [country code, city code, area code, exchange number, telephone number, extension number] of the authorized data steward.

B.6.9 Submitter organization name

Definition: A reference to the authority having responsibility for submitting a data concept proposal for registration.

Description: This is the organization assigned responsibility for identifying, documenting, and proposing data concepts for registration.

B.6.10 Submitter phone number

Definition: The telephone number [country code, city code, area code, exchange number, telephone number, extension number] of the responsible submitter organization.

B.6.11 User

Definition: An access name of a person who is authorized read-only access to the Data Dictionary or Data Registry.

Description: The values of this meta attribute are maintained via a controlled word list of authorized users.

B.6.12 View

Definition: A logical grouping of the Data Dictionary or Data Registry contents by data subject area, functional area, standard, application, application, or other demarcation.

B.6.13 Related groups

Definition: A designation of the ITS/TICS data stewards that may be impacted by changes to a given data concept.

B.6.14 Security class

Definition: A level of degree of protection of information against unauthorized access, associated with a data concept.

Description: Such protection relates to the degree of access permissible for a data concept.

NOTE Most security issues are envisioned as being specific to the use of a data element within an application context, but if there are general security criteria pertinent to a data element or other data concept, such as read/write/update rights..

EXAMPLE Personal privacy issues, proprietary data, financial data, etc.

Annex C
(normative)

Contents of the ITS/TICS Data Registry and ITS/TICS Data Dictionaries: Meta attribute requirements for data concepts

C.1 Introduction

This annex presents a set of tables that delineate the requirements for inclusion of meta attributes in the ITS/TICS Data Registry for each data concept. A second set of tables delineate the requirements for inclusion of meta attributes in an ITS/TICS Data Dictionary for each data concept. The definition of the meta attributes in this annex are to be found in Annex B (Contents of the ITS/TICS Data Registry and ITS/TICS Data Dictionaries: Meta attribute definitions).

Rows denote the meta attributes required for each data concept. The first column of each row provides the name of the meta attribute. The clause number, wherein the meta attribute is defined, is given in the second column. The next nine columns list the data concepts that may be documented in a Data Registry or a Data Dictionary. The last column is for any notes pertinent to the meta attribute and its relationship to each of the data concepts.

Each cell of the table contains a code that indicates whether the meta attribute on a particular row is mandatory, optional, contingent, indicative, automatically assigned, or not applicable for the data concept in a particular column. These codes are as follows:

— “M” = mandatory. Mandatory meta attributes are required for the referenced data concept, without exception.

— “O” = optional. Optional meta attributes may be implemented if desired by the functional-area Data Dictionary.

— “C” = contingent. Contingent meta attributes are those that depend upon the implementation of an optional meta-attribute. They are required when the optional meta-attribute upon which they depend is implemented.

— “I” = indicative. Indicative meta attributes depend upon an “if” condition that is independent of any other meta-attribute. If the “if” condition is applicable, then the “I” coded meta-attribute is mandatory; otherwise, it is not applicable.

— “A” = Assigned. The value of this meta attribute is automatically assigned for data concepts entered into the ITS/TICS Data Registry.

— “N/A” = not applicable.

The note column of each table explains the nature of each contingent or indicative meta attribute and provides other explanatory information.

NOTE Only single values are permitted for each meta attribute unless specifically identified as “Multiples Allowed”.

C.2 Meta attribute requirements for the ITS/TICS Data Registry

Table C.1 defines which of the basic meta attributes are required for data concepts in the ITS/TICS Data Registry. Data registries are intended to document all data concepts for an enterprise.

Table C.2 shows the administrative meta attribute requirements for data concepts in the ITS/TICS Data Registry.

Table C.1 — Basic meta attributes for the ITS/TICS Data Registry

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Data concept identifier	B.2.1	A	A	A	A	A	A	A	A	A	The value of this meta attribute is maintained automatically by the ITS/TICS Data Registry.
Data concept version	B.2.2	A	A	A	A	A	A	A	A	A	The value of this meta-attribute is maintained automatically by the ITS/TICS Data Registry.
Descriptive name [a]	B.2.3	M	M	M	M	M	M	M	M	M	—
Synonymous descriptive names	B.2.4	O	O	O	O	O	O	O	O	O	Multiples allowed
Symbolic names	B.2.5	N/A	N/A	N/A	N/A	O	O	O	O	N/A	Multiples allowed
ASN.1 name [a]	B.2.6	N/A	N/A	M	N/A	M	M	M	M	N/A	—
ASN.1 object identifier	B.2.7	M	M	M	M	M	M	M	M	M	
Uniform resource locator	B.2.8	I	I	I	I	I	I	I	I	I	
Definition [a]	B.3.1	M	M	M	M	M	M	M	M	M	—
Descriptive name context [a]	B.3.2	M	M	M	M	M	M	M	M	M	Multiples allowed
Symbolic name usage	B.3.3	N/A	N/A	N/A	N/A	C	C	C	C	N/A	“C” = Required when B.2.5 is optioned. Multiples allowed
Source	B.3.4	O	O	O	O	O	O	O	O	O	Multiples allowed
Architecture reference [b]	B.3.5	O	O	O	O	O	O	M	M	O	One or more framework ITS/TICS architecture reference(s) is required for messages and dialogues. Multiples allowed
Architecture name [b]	B.3.6	C	C	C	C	C	C	M	M	C	“C” = Required when B.3.5 is optioned. Multiples allowed corresponding to multiple instances of B.3.5

Table C.1 *(continued)*

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Architecture version [b]	B.3.7	C	C	C	C	C	C	M	M	C	"C" = Required when B.3.5 is optioned. Multiples allowed corresponding to multiple instances of B.3.5
Data concept type	B.3.8	M	M	M	M	M	M	M	M	M	—
Remarks	B.3.9	O	O	O	O	O	O	O	O	O	—
Context	B.3.10	O	O	O	O	O	O	O	O	O	
Standard	B.3.11	O	O	M	O	M	M	M	O	O	—
Metadata source	B.3.12	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	N/A	—
Priority	B.3.13	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	N/A	—
Frequency/ message mode	B.3.14	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	N/A	
Delivery verification	B.3.15	N/A	N/A	N/A	N/A	N/A	N/A	O	N/A	N/A	
Data quality	B.3.16	N/A	N/A	N/A	O	O	N/A	N/A	N/A	N/A	
Precursor [c]	B.4.2	O	O	O	O	O	O	O	O	O	Multiples allowed
Successor [c]	B.4.3	O	O	O	O	O	O	O	O	O	Multiples allowed
Synonym [c]	B.4.4	O	O	O	O	O	O	O	O	O	Multiples allowed
Abstract [c]	B.4.5	M	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Roles [c]	B.4.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	
Multiplicity [c]	B.4.7	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	
Association Constraints [c]	B.4.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	
Aggregate [c]	B.4.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	
Role Key [c]	B.4.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	
Referenced messages [c]	B.4.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	Multiples allowed
Referenced data frames [c]	B.4.12	N/A	N/A	N/A	N/A	O	O	M	O	N/A	Multiples allowed
Referenced data elements [c]	B.4.13	C	N/A	N/A	N/A	O	M	M	O	N/A	Multiples allowed "C" = required when any referenced association exists
Referenced object classes [c]	B.4.14	O	N/A	N/A	O	O	N/A	N/A	M	M	Multiples allowed
Referenced associations [c]	B.4.15	N/A	N/A	N/A	O	O	N/A	N/A	C	N/A	Multiples allowed "C" = Required when any referenced association exists

Table C.1 *(continued)*

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Data type [a]	B.5.1	N/A	N/A	M	N/A	M	M	M	O	N/A	Defined per ISO 8824, ASN.1
Format	B.5.2	N/A	N/A	M	N/A	M	N/A	N/A	N/A	N/A	—
Unit of measure	B.5.3	N/A	N/A	M	N/A	M	N/A	N/A	N/A	N/A	—
Valid value rule	B.5.4	N/A	N/A	M	N/A	M	N/A	N/A	N/A	N/A	The valid value rule may be expressed as a range, a list, or a function/algorithm.

[a] Considered a minimum essential meta attribute

[b] Vectors interface specifics to architecture/ information model.

[c] Data modelling requirement

Table C.2 — Administrative meta attributes for the ITS/TICS Data Registry

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Registration status	B.6.1	M	M	M	M	M	M	M	M	M	—
Date registered	B.6.2	A	A	A	A	A	A	A	A	A	The value of this meta attribute is maintained automatically by the registry.
Last change date	B.6.3	A	A	A	A	A	A	A	A	A	The value of this meta-attribute is maintained automatically by the registry.
Last change user	B.6.4	A	A	A	A	A	A	A	A	A	The value of this meta-attribute is maintained automatically by the registry.
Registrar organization name	B.6.5	M	M	M	M	M	M	M	M	M	—
Registrar phone number	B.6.6	M	M	M	M	M	M	M	M	M	—
Steward organization name	B.6.7	M	M	M	M	M	M	M	M	M	Required for data concepts at registration quality level of Qualified or higher

Table C.2 *(continued)*

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Steward phone number	B.6.8	M	M	M	M	M	M	M	M	M	Required for data concepts at registration quality level of Qualified or higher
Submitter organization name	B.6.9	A	A	A	A	A	A	A	A	A	—
Submitter phone number	B.6.10	M	M	M	M	M	M	M	M	M	—
User	B.6.11	A	A	A	A	A	A	A	A	A	The value of this meta-attribute is maintained automatically by the ITS Data Registry. Multiples allowed
View	B.6.12	O	O	O	O	O	O	O	O	O	—
Related groups	B.6.13	I	I	I	I	I	I	I	I	I	"I" = Required when a change in a data concept may impact other ITS functional-area Data Dictionaries Multiples allowed
Security class	B.6.14	O	O	O	O	O	O	O	O	O	—

C.3 Meta attribute requirements for ITS/TICS Data Dictionaries

Table C.3 defines which of the basic meta attributes are required for data concepts in ITS/TICS Data Dictionaries. ITS/TICS Data Dictionaries are primarily intended to document data elements data frames and messages, although documentation of other data concepts, such as object classes, properties, value domains, or data element concepts, may be included. A valid ITS/TICS Data Dictionary shall incorporate all mandatory meta attributes of each data element, data frame and message of the set. In addition, an ITS/TICS Data Dictionary may include documentation of other data concepts, such as object classes, associations, properties, value domains, or data element concepts.

Table C.4 shows the administrative attribution requirements for data concepts in ITS/TICS Data Dictionaries.

Table C.3 — Basic meta attributes for ITS/TICS Data Dictionaries

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Data concept identifier	B.2.1	O	O	O	O	O	O	O	O	O	ITS/TICS Data Dictionary authorities should find this meta attribute useful.
Data concept version	B.2.2	O	O	O	O	O	O	O	O	O	ITS/TICS Data Dictionary authorities should find this meta attribute useful.
Descriptive name [a]	B.2.3	M	M	M	M	M	M	M	M	M	Required if data concepts are contained in the Data Dictionary.
Synonymous descriptive names	B.2.4	O	O	O	O	O	O	O	O	O	Multiples allowed
Symbolic names	B.2.5	N/A	N/A	N/A	N/A	O	O	O	O	N/A	Multiples allowed
ASN.1 name [a]	B.2.6	N/A	N/A	M	N/A	M	M	M	M	N/A	—
ASN.1 object identifier	B.2.8	M	M	M	M	M	M	M	M	M	
Uniform resource locator	B.2.9	I	I	I	I	I	I	I	I	I	
Definition [a]	B.3.1	M	M	M	M	M	M	M	M	M	—
Descriptive name context [a]	B.3.2	M	M	M	M	M	M	M	M	M	Multiples allowed
Symbolic name usage	B.3.3	N/A	N/A	N/A	N/A	C	C	C	C	N/A	“C” = Required when B.2.5 is optioned. Multiples allowed
Source	B.3.4	O	O	O	O	O	O	O	O	O	Multiples allowed.
Architecture reference [b]	B.3.5	O	O	O	O	O	O	O	O	O	One or more framework ITS/TICS architecture reference(s) is required for messages and dialogues. Multiples allowed
Architecture name [b]	B.3.6	C	C	C	C	C	C	M	M	C	“C” = Required when B.3.5 is optioned. Multiples allowed corresponding to multiple instances of B.3.5

Table C.3 *(continued)*

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Architecture version [b]	B.3.7	C	C	C	C	C	C	M	M	C	"C" = Required when B.3.5 is optioned. Multiples allowed corresponding to multiple instances of B.3.5
Data concept type	B.3.8	M	M	M	M	M	M	M	M	M	—
Remarks	B.3.9	O	O	O	O	O	O	O	O	O	—
Context	B.3.10	O	O	O	O	O	O	O	O	O	
Standard	B.3.11	O	O	M	O	M	M	M	O	O	—
Metadata source	B.3.12	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	N/A	—
Priority	B.3.13	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	N/A	
Frequency/ message mode	B.3.14	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	N/A	
Delivery verification	B.3.15	N/A	N/A	N/A	N/A	N/A	N/A	O	N/A	N/A	
Data quality	B.3.16	N/A	N/A	N/A	O	O	N/A	N/A	N/A	N/A	
Precursor [c]	B.4.2	O	O	O	O	O	O	O	O	O	Multiples allowed
Successor [c]	B.4.3	O	O	O	O	O	O	O	O	O	Multiples allowed
Synonym [c]	B.4.4	O	O	O	O	O	O	O	O	O	Multiples allowed
Abstract [c]	B.4.5	M	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Roles [c]	B.4.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	
Multiplicity [c]	B.4.7	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	
Association Constraints [c]	B.4.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	
Aggregate [c]	B.4.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	
Role Key [c]	B.4.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	
Referenced messages [c]	B.4.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	M	N/A	Multiples allowed
Referenced data frames [c]	B.4.12	N/A	N/A	N/A	N/A	O	O	M	O	N/A	Multiples allowed
Referenced data elements [c]	B.4.13	C	N/A	N/A	N/A	O	M	M	O	N/A	Multiples allowed "C" = required when any referenced association exists
Referenced object classes [c]	B.4.14	O	N/A	N/A	O	O	N/A	N/A	M	M	Multiples allowed

Table C.3 *(continued)*

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Referenced associations [c]	B.4.15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C	N/A	Multiples allowed "C" = Required when any referenced association exists
Data type [a]	B.5.1	N/A	N/A	M	N/A	M	M	M	O	N/A	Defined per ISO 8824, ASN.1
Format	B.5.2	N/A	N/A	M	N/A	M	N/A	N/A	N/A	N/A	—
Unit of measure	B.5.3	N/A	N/A	M	N/A	M	N/A	N/A	N/A	N/A	—
Valid value rule	B.5.4	N/A	N/A	M	N/A	M	N/A	N/A	N/A	N/A	The valid value rule may be expressed as a range, a list, or a function/algorithm.

[a] Considered a minimum essential meta attribute.

[b] Vectors interface specifics to architecture/ information model.

[c] Data modelling requirement.

Table C.4 — Administrative meta attributes for ITS/TICS Data Dictionaries

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Registration status	B.6.1	O	O	O	O	O	O	O	O	O	Required if data concept is in an ITS registration status of Working draft, Qualified, or Preferred.
Date registered	B.6.2	O	O	O	O	O	O	O	O	O	ITS/TICS Data Dictionary authorities should find this meta attribute useful.
Last change date	B.6.3	O	O	O	O	O	O	O	O	O	ITS/TICS Data Dictionary authorities should find this meta attribute useful.
Last change user	B.6.4	O	O	O	O	O	O	O	O	O	ITS/TICS Data Dictionary authorities should find this meta attribute useful.

Table C.4 *(continued)*

Meta attribute	Data concepts										Notes
	Subclause	Object class	Property	Value Domain	Data Element Concept	Data Element	Data Frame	Message	Interface Dialogue	Association	
Registrar organization name	B.6.5	O	O	O	O	O	O	O	O	O	Required if external registrar is the source.
Registrar phone number	B.6.6	O	O	O	O	O	O	O	O	O	—
Steward organization name	B.6.7	O	O	O	O	O	O	O	O	O	—
Steward phone number	B.6.8	O	O	O	O	O	O	O	O	O	—
Submitter organization name	B.6.9	O	O	O	O	O	O	O	O	O	—
Submitter phone number	B.6.10	O	O	O	O	O	O	O	O	O	—
User	B.6.11	O	O	O	O	O	O	O	O	O	ITS/TICS Data Dictionary authorities should find this meta attribute useful. Multiples allowed.
View	B.6.12	O	O	O	O	O	O	O	O	O	—
Related groups	B.6.13	I	I	I	I	I	I	I	I	I	"I" = Required when a change in a data concept may impact other ITS functional-area Data Dictionaries. Multiples allowed
Security class	B.6.14	O	O	O	O	O	O	O	O	O	—

Annex D
(normative)

Data concept names

D.1 Data concept descriptive name format

D.1.1 Overview

Formulation of descriptive names shall be accomplished by first formulating the terms associated with the most elemental concepts. For example, a data element name consists of a object class term, a property term, and a value domain term. Careful formulation of the names of data concept components promotes consistency of descriptive names and helps prevent development of duplicate descriptive names (i.e., same names for the different data concepts).

A number of general requirements apply to all data concept descriptive names. Proper names, spaces, prepositions, and conjunctions, or special characters (other than those noted below) are not allowed in descriptive data concept names.

D.1.2 Object class descriptive name format

An object class descriptive name indicates the object class relevant to the data concept. The structure of the object class descriptive name shall be

ObjectClassTerm

The object class descriptive name shall be constructed as a series of one or more words, designed to quickly convey the essential meaning of the object class to the reader as a singular noun. Each word within the descriptive name shall start with an initial upper-case letter followed by lower-case letters. The words shall immediately follow one another without any space. Hyphens shall only be used when their absence may cause confusion to the reader; in this case, the second part of the hyphenated word shall start with a lower-case letter. The maximum length of a object class descriptive name shall be 64 characters.

The object class descriptive name should only consist of alpha and numeric characters. Other than hyphen, no other character or space is permitted. The use of hyphen is discouraged because of potential conflicts with any conversion rules.

The intent of the ITS/TICS Data Registry is meant to convey information in an understandable format. While names may follow an object-oriented, class hierarchical naming convention, the order of qualifiers in the object class term is not prescribed. The allocation of qualifiers between the object class and property terms is also not prescribed.

D.1.3 Property descriptive name format

A property descriptive name indicates the information of interest about an object class. The information of interest might be a fact, proposition, or observation about the object class. The structure of the property descriptive name shall be

propertyTerm

The property descriptive name shall be constructed as a series of one or more words, designed to quickly convey the essential meaning of the property to the reader. An object may have multiple instances of the property, in which case it shall be in the plural form of a noun; otherwise it shall be in singular noun form. The initial word of the descriptive name shall be lower-case letters. Any subsequent words within the descriptive

name shall start with an initial upper-case letter followed by lower-case letters. The words shall immediately follow one another without any space. Hyphens shall never be used in the first word and shall only be used in subsequent words when their absence may cause confusion to the reader; in this case, the second part of the hyphenated word shall start with a lower-case letter. The maximum length of a property descriptive name shall be 64 characters.

The property descriptive name should only consist of alpha and numeric characters. Other than hyphen, no other character or space is permitted. The use of hyphen is discouraged because of potential conflicts with any conversion rules.

The property descriptive name is separated from the object class term by a period (".") and from its representational form (e.g., a value domain term) by a colon (":").

D.1.4 Value domain descriptive name format

A Value domain descriptive name is a name that indicates, precisely and unambiguously, the format and syntactic form for value domain instance values. The explicit value domain applicable to a data element using this value domain term should be specified in its value domain meta attribute. The structure of the value domain descriptive name shall be

value-domain-term

The value domain descriptive name shall be constructed as a series of one or more words, designed to quickly convey the format in which the information is represented. Each word shall be in all lower-case letters with hyphens separating words. The first word of the value domain descriptive name shall be one of the terms identified in this subclause in order to identify the general nature of value domain. The remaining words shall uniquely characterize the specific value domain. The maximum length of a value domain descriptive name shall be 32 characters.

The value domain descriptive name need not include text that uniquely characterizes the specific value domain if other fields in the ITS/TICS Data Registry convey that information.

The value domain terms and their abbreviations, as listed below, should be the value domain terms used for naming value domains themselves. Use of any other value domain terms should be avoided. A value domain term abbreviation should not be further abbreviated.

amount (amt): A numeric quantification of a monetary value expressed in monetary units, such as dollars and cents. An example explicit value domain for this value domain term should be $$$$.cc, where $$$$ represents dollars to whatever number of significant digits is required, and "cc" represents cents. For non-monetary numeric values, use the "quantity" value domain term.

code (cd): An alphanumeric character or symbol (or a string of characters or symbols) that represents a specific meaning, e.g., "T" for "True" and "F" for "False".

NOTE Example value domains: ANSI X3.38-1988, ISO 3166-1:1997, ISO 3166-2:1998, ISO 3166-3:1999, and ISO 5218:1977 are all of the representation class "code".

date (dt): A specific calendar day expressed in numeric format. The value domain reference specified for date should apply. No other value domains should be used for the date value domain term.

identifier (id): A value used to uniquely identify a Data Concept Instance of an object class.

image (img): A graphical or pictorial item, such as a map, diagram, picture, motion picture, or icon. An example explicit value domain applicable to a data element using this value domain term should be specified in its value domain meta-attribute (e.g., jpeg, mpeg, gif).

location (lctn): A three dimensional geographical point on, under, or above the earth. The value domain reference specified for latitude/longitude/altitude should apply. No other value domains should be used for the location value domain term.

number (nbr): A non-computational numeric or alphanumeric string used to designate an item, e.g., a serial number, telephone number, street number, apartment number, or social security number. The explicit value domain for the representation class "number" is ISO 10646.

percent (pct): A ratio of two quantities expressed in numeric format as a decimal number multiplied by 100. An example explicit value domain for the representation class "percent" is 999.999, with however many significant digits are necessary for each of the whole number and decimal fraction portions of the number. Such percents are positive or negative integers.

quantity (qty): A non-monetary numeric value subject to computational manipulations. An example explicit value domain for the representation class "quantity" is the set of all real or imaginary numbers.

rate (rt): A numeric unit of measure expressing the ratio of a quantity to another quantity, for example, "miles per hour," "gallons per hour," and "dollars per day." An example explicit value domain for "rate" is the positive or negative integers. The specific ratio for a data element using this representational class term should be specified in the valid value rule meta-attribute.

sound (snd): An audio sequence with explicit beginning and end. An example explicit value domain applicable to a data element using this value domain term should be specified in its value domain meta-attribute, e.g., "wav."

text (txt): An alphanumeric string (formatted or unformatted), e.g., a street name, or the contents of a document, message, or other file. An example explicit value domain for "text" is ISO 10646.

UTC (utc): A specific point in UTC-based time in a calendar day expressed in terms of hours, minutes, and, optionally, seconds and decimal seconds. The value domain reference specified for UTC-based time should apply. No other value domain term for that value domain reference should be used.

GPS (gps): A specific point in GPS time in a calendar day expressed in terms of seconds since midnight on the night of 5 January 1980/morning of 6 January 1980. GPS may differ from UTC as UTC is corrected periodically with an integer number of leap seconds. The value domain reference specified for GPS-based time should apply. No other value domain term for that value domain reference should be used. Alternatively employ Global Navigation Satellite System (GNSS/gnss) as the value domain reference.

D.1.5 Data element concept descriptive name format

A data element concept descriptive name is a name that identifies a data element concept. The structure of the data element concept descriptive name shall be

ObjectClassTerm.propertyTerm

D.1.6 Data element descriptive name format

A data element descriptive name is a name that identifies a data element. The structure of the data element descriptive name shall be

ObjectClassTerm.propertyTerm:value-domain-term

D.1.7 Data frame descriptive name format

A data frame descriptive name is a name that summarizes the contents of the data frame. The structure of the data frame descriptive name shall be

DataFrameTerm:frame

The structure is identical to that of the object class descriptive name, except that it may be plural and that it shall be followed by the string literal ":frame".

D.1.8 Message descriptive name format

A message descriptive name is a name that captures the essence of the purpose of the message. The structure of the message descriptive name shall be

MessageTerm:message

The structure is identical to that of the object class descriptive name, except that it may be plural and that it shall be followed by the string literal ":message".

D.1.9 Interface dialogue descriptive name format

An interface dialogue descriptive name is a name that captures the essence of the purpose of the interaction. It shall be based upon the architectural subsystems which support the interface dialogue and an identifier of that subsystem. The structure of the interface dialogue descriptive name shall be

SourceName<-InterfaceDialogue->DestinationName

D.1.10 Association descriptive name format

An association descriptive name is a name that captures the essence of the purpose of an association. The structure of the association descriptive name is

RoleAObjectclassTerm<<associationtype>> RoleBObjectclassTerm

D.1.11 Context descriptive name term format

The context descriptive name term identifies the document within which the data concept is identified. The structure of the context descriptive name term shall be

OrganizationIdentifier-DocumentIdentifier

The context descriptive name term shall consist of an organization identifier and a document identifier. The registrar shall assign a globally unique organization identifier to any organization wishing to register data concepts. The organization shall then assign a document identifier to each document from which it proposes data concepts and shall ensure that each document identifier is unique within its organization. These two identifiers are then combined, separated by a hyphen. For example, the context descriptive name is

ISO-14817

All OrganizationIdentifiers shall be defined as 3-6 uppercase, alphabetic (A-Z) characters. The registrar shall maintain a list of agreed upon OrganizationIdentifiers and include them in the operating procedures.

All DocumentationIdentifiers shall be defined as 3-8 uppercase alphabetic (A-Z) or numeric characters, or spaces. No special extra delimiters are permitted.

D.1.12 Fully-qualified descriptive name formats

Because there is a large number of independent groups that may develop data concepts, it would be problematic to require globally unique descriptive names for every data concept. Instead, this International Standard only requires a descriptive name to be unique within the scope of the defining standard or document. In addition, any standard or document that defines one or more data concepts to be stored in the ITS/TICS Data Registry is required to have a context descriptive name.

Whenever a reference is made to a data concept that is formally defined in another document, the reference shall use the fully qualified descriptive name. The fully qualified descriptive name of any data concept is obtained by concatenating the context descriptive name with a double colon and the descriptive name of the data concept. Thus the structure of a fully qualified descriptive name for an object class would be

OrganizationIdentifier-DocumentIdentifier::ObjectClassTerm

D.2 Abbreviations and acronyms

Abbreviations and acronyms are often required for readability. They shall only be used when the intended audience of the document should already be familiar with the terms. The maximum length of abbreviated names shall be 162 characters (inclusive of separators).

D.3 Converting ITS/TICS descriptive names to ASN.1 names

D.3.1 Overview

The convention for developing descriptive names for data elements and other data concept types represented in ITS/TICS Data Dictionaries is given above. Data element names developed using this naming convention may differ somewhat from the names for those data elements when they are represented in a message specification using ASN.1 syntax and associated naming rules. The descriptive data element names can be converted to ASN.1 names using the guidelines described in this clause. The ASN.1-conforming name shall be represented in an ITS/TICS Data Dictionary using the meta attribute called ASN.1 Name, which is a meta attribute mandatory for all value domains, data elements, data frames, messages, and interface dialogues.

D.3.2 Use of ASN.1 syntax

The ASN.1 naming rules are as follows:

— The set of characters from which names can be formed in ASN.1 are: A-Z, a-z, hyphen, 0-9.

— Typereferences are names that must start with a capital letter.

— Identifiers are names that must start with a lower case letter.

— A name (i.e., a typereference or an identifier) cannot contain two or more contiguous hyphens, nor start or end with a hyphen. Note that ASN.1 names are case-sensitive.

— While no maximum length is placed on names by ASN.1; this International Standard limits names by way of this annex.

In the following example

```
PersonnelInfo ::= SEQUENCE {
    name          PersonName,
    age           Age,
    address       HomeAddress
}
PersonName    ::= VisibleString (SIZE(1..64))
Age           ::= INTEGER (0..160)
HomeAddress   ::= VisibleString (SIZE(1..100))
```

or alternatively,

```
PersonnelInfo ::= SEQUENCE {
   name           VisibleString (SIZE(1..64)),
   age            INTEGER (0..160),
   address        VisibleString (SIZE(1..100))
}
```

PersonnelInfo, PersonName, Age, and HomeAddress are typereferences; name, age, and address are identifiers. The typereferences for field names — properties, in ITS/TICS Data Dictionary terminology — may be omitted, as they serve only an intermediary purpose.

NOTE For ITS/TICS messages, the data types and field size metadata are given in the Data Dictionary.

An equivalent of this example in the C programming language would be:

```
typedef char            PersonName[65];
typedef unsigned short  Age;
typedef char            HomeAddress[101];

typedef struct {
     PersonName     name;
     Age            age;
     HomeAddress    address;
     }PersonnelInfo;
```

The process for converting from the descriptive name for a data concept in an ITS/TICS Data Dictionary to an ASN.1-conforming name is as follows:

The object class term from the Data Dictionary descriptive name is verified as the first letter of each word uppercase and the rest lowercase. Any hyphens in terms, as well as all underscores used as separators in the case of modifiers, are removed. The modifier(s) should be placed in front of the primary object class term. The term may become a separate ASN.1 typereference, and/or when needed to avoid ambiguity, may be applied as part of the typereference created for the property term. In the latter case, the period between the class term and the property term is removed. A hyphen may be placed between the class term and the property term, including for use as a substitute for a removed underscore.

The property term from the Data Dictionary descriptive name is converted to all lowercase. Hyphens are added between compound words in terms formed from compound words (unless such hyphens are already present). The term becomes an ASN.1 identifier. An optional intermediate state may be shown if the property term is explicitly specified in ASN.1 as being a field name or identifier in a sequence. At a minimum it may be treated as a field name or identifier in a sequence associated with its class. The property term is represented in the same form as it was in the Data Dictionary, but in this case becomes an ASN.1 typereference. The typereference for its associated class term may be prepended to the property term to avoid ambiguity; it is then used essentially as a qualifier, and may become an indistinguishable part of the typereference for the property term (unless a hyphen is added between the class term and the property term). The typereference for the property term is mapped to the identifier for that same term.

The value domain name and the data type are not used.

Annex E
(informative)

Data representation in an information model

E.1 Introduction

In order to exchange information and make effective use of it, communicating systems should have a common understanding of the data to be exchanged. This includes a common understanding of the semantic relationships between various pieces of data as well as its syntactic representation. Any disagreement over these relationships is likely an indication of differing semantic meanings of the data, which must be resolved. However, when developing the consensus about these relationships, parties should remember that a common understanding of data across an interface does not require identical implementations internal to a system.

The data relationships defined for an interface should be designed to support a superset of all information exchange needs across the interface. However, any given system may support only a small subset of the defined interface functions and may additionally provide other features not associated with the interface. The most appropriate design of a system is dependent on all of the functional requirements of that system with the interface definition being just one requirement. As such, each system will likely use its own implementation-specific representation of data internally. The internal relationships are defined by a database schema, object model, or some other technique and are then translated as needed into the generic representation defined by the interface definition.

Because many system designers must understand the interface definition, it is critical that it is well documented. Experience suggests that one of the best human-readable ways to express these relationships is through the use of information models. These information models may then be converted into computer readable formats as needed.

This annex defines guidelines for producing information models within the ITS/TICS domain. They are based on the data concepts defined in subclause 6.4 and illustrated in the example below using the graphical notation of the Unified Modeling Language.

NOTE A tutorial of UML with transport applications is available in ISO/TR 14813-4:2000. See also the specification for UML 1.3 in ISO/IEC 19501-1 (to be published).

E.2 Information modeling example

Information modeling is herein described through the use of an example. A single example is used in this annex to present the basic philosophy as well as to demonstrate the rules and guidelines defined by this International Standard. The example describes a generic relationship between a Stop Point and a Line, as defined in the Public Transport Feature of the Geographic Data File standard (GDF 4.0, ISO 14825).

In GDF, all elements regarding the public transport network are grouped in a feature theme call *Public Transport*. This theme contains all the public transport basic features which can be related with a geometrical position. A *Stop Point* is a point where passengers can board or alight a public transport vehicle. A *Line* is a group of Routes which is known by a common name or number. In its simplest form, the relationship between Stop Point and Line could be viewed as a simple association between two object classes as shown in Figure E.1.

The figure depicts two object classes: StopPoint and Line, denoted as rectangles with the object class name in the top partition. A line connecting the two rectangles represents an association and the adornments at each end of the line characterize that association. The figure also depicts four properties that have been assigned to object class StopPoint which are stopIdentifier, stopType, nationalID, and lines. Three of the properties are included in the attribute partition of the object class rectangle while the fourth property (lines) is placed next to the object class Line to denote the role performed by the Line object class in association with the StopPoint object class. There are three properties assigned to Line: lineName, lineOperator, and stops. Two of the properties are included in the object class rectangle while the third (stops) is placed next to the object class StopPoint to denote the role performed by the StopPoint object class in association with the Line object class. The "stops" property of Line may have a number of instances (i.e., a Line is associated with n StopPoints) and a StopPoint is associated with zero to n instances of Line. Finally, the figure indicates that the value domain "String" defines the representational form of stopIdentifier.

However, some systems may wish to record more structural semantics pertaining to this public transport context. To this end, Figure E.2 provides a more comprehensive set of data and relationships. This representation provides all of the information provided in the previous example, plus additional information about the StopPoint's participation in different contexts. See Table E.1 for a summary and examples of StopPoint relationships. The example StopPoint instance, "Regent Street 1200-1," is part of an express route which may have only a few other StopPoints between its origin and destination. At the same time, "Regent Street 1200-1" is on two other Routes which act as feeder routes. Thus, "Regent Street 1200-1" is simultaneously registered with three Routes, while many or all of the StopPoints on the feeder routes may be part of just one Route.

The comprehensive model also indicates that Line identifies StopPoint through the assigned identifier (stopNumber), while StopPoint connects to its various Routes by routeNumber and lineName. The comprehensive model also indicates that a given Route (instance) may be associated with none or only one Line. Finally, the model indicates that the maximumRouteTravelTime is only relevant in the model if Route is an On-Demand Route, in which case, averageServiceInterval is also recorded for traveller information purposes.

An alternative third view of this model is depicted in Figure E.3. This diagram allows a system to store all of the information defined in Figure E.2, but it does not provide the reader with some of the more specific semantic relationships. For example, Figure E.3 omits any relationship between the first routeDestination and the first routeOrigin. This does not mean that none exists, but the model does not call out this detail. Nonetheless, an implementer could easily develop a system based on the third model while applying the rules defined in the second model and be able to successfully provide the same data as provided in Figures E.1 and E.2.

Thus, Figure E.1 and E.3 are valid implementation models for the information model defined by Figure E.2 (although the system implementing Figure E.1 would only support a subset of the defined information). The intent behind information modeling is to precisely define the data and relationships so that all parties involved understand the intent of the model but an implementation of the model is allowed to simplify the design in order to meet other system requirements.

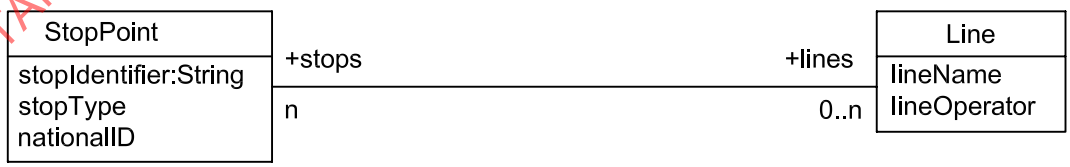


Figure E.1 — Simple information model

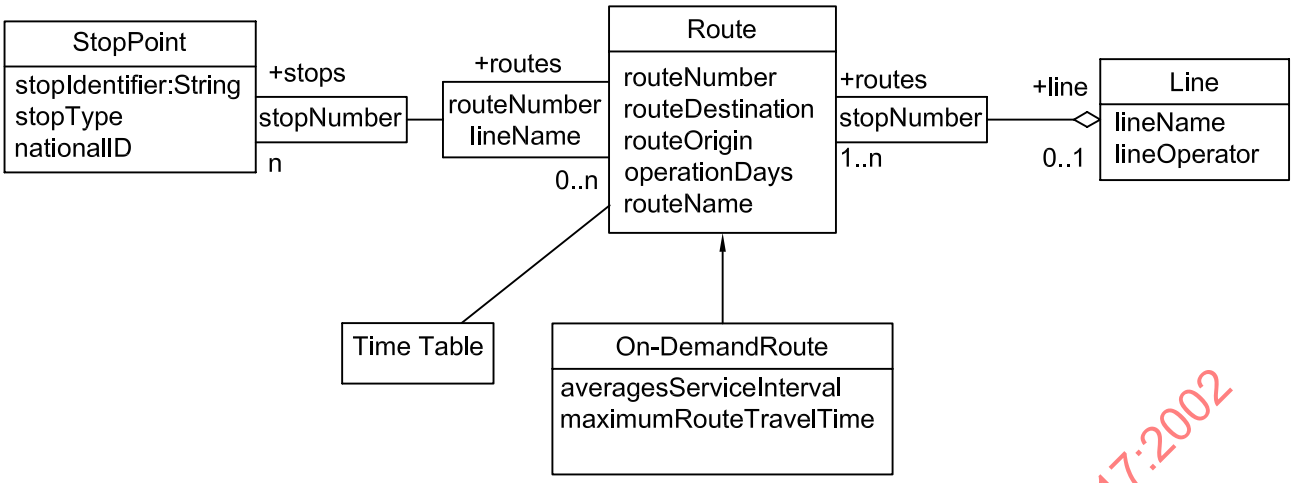


Figure E.2 — Comprehensive information model

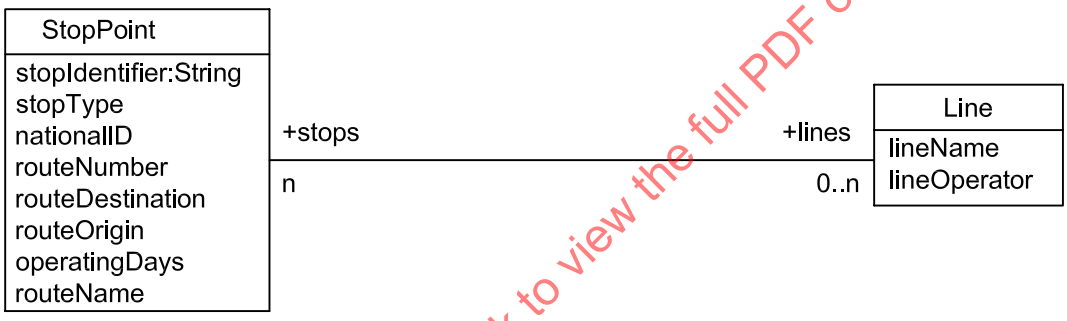


Figure E.3 — Implementation information model

Table E.1 — StopPoint relationships

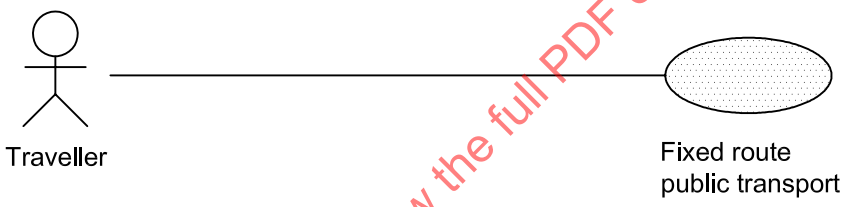
ObjectClass:	**StopPoint**	**Route**		**Line**
Property:	**stopIdentifier**	**routeOrigin**	**routeName**	**lineName**
Value Domain:	**String**	**String**	**String**	**String**
Instance:	Regent Street 1200-1	Green Square	Green Square inbound express	Penfield Station
Instance:	Regent Street 1200-1	Templestowe	Templestowe-Lipton	Templestowe District
Instance:	Regent Street 1200-1	Longfield	Longfield-Templestowe	Templestowe District
Instance:	Lavender Lane 200-1	Templestowe	Templestowe-Lipton	Templestowe District
Instance:	Fountain Circuit 400-2	Longfield	Longfield-Templestowe	Templestowe District

E.3 Information interchange example

The Data Registry process defined within this International Standard is consistent to enable implementation(s) of the ISO ITS/TICS architecture as defined in ISO/TR 14813 Parts 2 and 3. However, this does not preclude the application of the ITS/TICS Data Registry using alternative International, Regional or National System Architecture methodologies or techniques, indeed, a common Data Registry will ease migration and interoperability between such approaches. The data concepts to be entered in a Data Dictionary or Data Registry will be traceable to some ITS system architecture. The Reference model architectures for the TICS sector defined in ISO 14813 include a methodology for developing an architecture (see ISO 14813-2, Annex A). The example below sketches how data concepts would arise in that methodology and illustrates some of the important meta attributes to be recognised for a Data Dictionary or Data Registry.

The data modelling meta attributes required to document data concepts in a Data Dictionary or Data Registry are listed in the tables in Annex C. The most important data modelling meta attributes applicable to an Information Dialogue are illustrated by the following example. The example is based on the semantics of the information model of Figure E.2.

The example information dialogue is derived from the public transport use case diagram in ISO 14813-2 Figure 19. A small part of that diagram is reproduced in Figure E.4. Figure E.4 depicts the provision of public transport information to a traveller.



NOTE The graphic symbols are from the Unified Modeling Language. The stick figure denotes an actor — an external system or user — that obtains or participates in the functionality of the ITS system. The ellipse denotes a unit of functionality called a use case. A use case delivers meaningful results to one or more actors.

Figure E.4 — Public transport use case diagram (subset)

The interface dialogue pertaining to an information interchange between travellers and a bus fixed route public transport service could support many types of queries pertaining to routes and timetables. This is depicted by the high level interaction in ISO 14813-3 Figure 51 labelled “access public transport running data”. In Figure E.5 a UML interaction diagram is shown that would support the specific query “where does route 2 of the Penfield line stop?” The interaction diagram is representing the interface dialogue between one object class instance (a traveller at a particular travel terminal) and another object class instance (Penfield Line, a particular public transport line). By definition the UML interaction diagram represents time running vertically down the diagram. Additional examples pertinent to the proposed interface would require further elaboration of Table E.5 and corresponding elaboration of the TimeTable object class in Figure E.2.

The referenced data concepts of the example are described in Table E.2. The cells in Table E.2 correspond to instances of key mandatory meta attributes specified in Table C.1 relating to the interface dialogue. The values in each cell (e.g. “id1”) denote unique identifiers for data concept instances. These values would be implemented using one of the meta attributes defined in Table C.1 that are unique data concept identifiers (e.g. data concept identifier or ASN.1 object identifier). Using a top down approach, the interface dialogue, Traveller<<BusQuery>>ISP, references messages with Data Concept IDs (DCIDs) of m1 and m2. Message m1, RouteRequest():message, references a single data element whose DCID is de2 and whose Descriptive Name is Route.routeNumber:identifier. Route.routeNumber:identifier references the object class whose DCID is c2 and whose Descriptive Name is Route. This then may be related back to Figure E.2 where routeNumber is identified as a property of the object class Route. In like fashion, the relationships surrounding message m2 may be traced. Additional model information is contained in the association data concepts a1 and a2 which represent the relationships among the three object classes presented in Figure E.2.

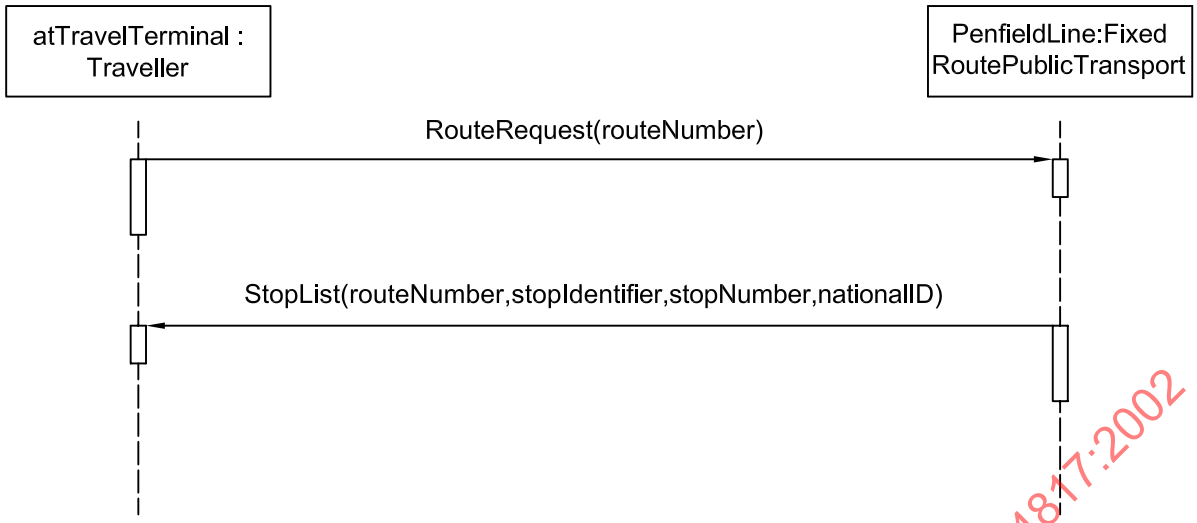


Figure E.5 — Interaction diagram for bus query

NOTE The interface dialogue may be a sequence of a set of messages and a set of messages. Time runs vertically down the diagram.

Table E.2 — Interface dialogue meta attributes

Data ConceptID	Data Concept Type	Descriptive Name	Definition	Ref. Data Elements	Ref. Classes	Ref. Associations	Ref. Messages	Role Key
id1	Interface Dialogue	Traveller<-BusQuery->ISP	Enables the information service provider to satisfy the query: what are the stop points on a route?		c1, c2, c3	a1, a2	m1, m2	
m1	Message	RouteRequest :message	Enables remote traveller support to pose the query: what are the stop points on a route?	de2				
m2	Message	Stop List:message	Enables the information service provider to issue the results of the query: what are the stop points on a route?	de2, de3, de4, de5				
de1	Data Element	Line.lineName :text	The name of a public transport Line		c1			
de2	Data Element	Route. routeNumber: identifier	An identifier of a Route on a public transport Line		c2			
de3	Data Element	StopPoint.stop Identifier: identifier	An identifier in a limited context for a public transport Stop Point		c3			
de4	Data Element	StopPoint.stop Number: number	An ordering of a public transport StopPoint in a Route		c3			
de5	Data Element	StopPoint. nationalID: identifier	A national identifier for a public transport StopPoint		c3			
c1	Object Class	Line	The object class used to describe all public transport lines	de1				
c2	Object Class	Route	The object class used to describe all public transport routes	de2				
c3	Object Class	StopPoint	The object class used to describe all public transport stop points	de3, de4, de5				
a1	Association	Line <-aggregate-> Route	Aggregation of public transport Routes in a Line		c1, c2			rk1
a2	Association	Route<-composition-> StopPoint	Relates a Route to its Stop Points		c2, c3			rk2
rk1	(association attribute)	<Route>	Identifies a Route in the association a1	de2				
rk2	(association attribute)	<StopPoint>	Identifies a StopPoint in the association a2	de4				

E.4 Guide for Information Modeling

E.4.1 ITS/TICS data used in interchanges should be represented in an information model

In order to achieve interoperability, a common understanding of the semantic relationships among data is critical. Experience suggests that information models provide a useful tool in documenting these relationships. As such, all data concepts should be documented within an information model prior to being promoted to the Qualified registration status.

E.4.2 UML class diagrams should be used to depict the information models

Over time, there have been a variety of modeling techniques developed for depicting relationships among data. The UML has merged the concepts found in many of these techniques and has now become the most widely recognized methodology for documenting relationships. As such, the ITS/TICS domain should use UML to depict the data concepts recorded in any ITS/TICS Data Dictionary and the ITS/TICS Data Registry. This requirement includes the depiction of associations and specializations.

E.4.3 Use only the subset of the UML identified in this annex when developing the UML diagrams

This annex establishes a baseline of features that are considered appropriate for various target audiences of ITS/TICS standards. It also serves as a guide in how to read the notations and a rulebook in how to map between the Data Dictionary format and the UML. Authors of ITS/TICS standards should remember that the UML diagrams are intended to provide an overview of the information domain; the full detailed semantics of the information domain is always incorporated into the contents of the Data Dictionary and the ITS/TICS Data Registry.

Nonetheless, if the developers of a standard discover a special need to use other notations, the subject standard should include explanatory text in order to explain the semantics implied by the diagrammatic technique.

NOTE The UML is a very comprehensive, robust language and many readers of ITS/TICS standards may not be familiar with its more sophisticated features. Consequently, some of the more complex notations should be avoided so as not to confuse readers or discourage stakeholders from reading and using the standards.

E.4.4 Each object class defined should be represented in at least one UML class diagram

The UML class diagram may display more than one object class and a given object class may appear in more than one diagram.

The class name compartment should be present for all object classes shown in the diagram. Abstract object classes should be depicted with their class names in italics.

The attributes and operations compartments of a UML class diagram may be omitted for any object class.

If an object class is a specialization of another object class, the relationship should be depicted in at least one UML class diagram. The Data Dictionary specialization is identical to a UML specialization. The diagram may show multiple levels of specialization, but it is not required.

E.4.5 All component data element concepts of the object class should be identified within a UML class diagram

Data element concepts should be depicted as either attributes of the subject class or role names for classes associated with the subject class. The attribute/role name should be identical to the descriptive name of the property described by the data element concept.

A data element concept that is depicted as an attribute and has a multiplicity that may exceed one (1) should be depicted as an array by including a pair of square brackets (“[]”) after the attribute name.

NOTE While each data element concept must be depicted in at least one UML class diagram, it is not a requirement to depict all data element concepts for a given object class in a single UML diagram. This flexibility is provided such that the domain experts are able to structure the class diagrams for maximum readability; which may be best achieved by showing this information in a series of diagrams rather than in a single diagram. There may also be cases where attributes only apply in certain cases.

E.4.6 The value domain may be displayed when there is a single representation

If a data element concept is only associated with a single data element (i.e. representational form), the value domain for that data element may be indicated in the UML class diagram. Otherwise, the class diagram should not depict any value domain for the data element concept.

When shown, a value domain should be indicated as the UML data type of the associated attribute (i.e. converting the data element concept representation into a data element representation). The type name should be identical to the descriptive name of the associated value domain.

NOTE It follows that data elements correspond to class-attribute-type triples in UML.

E.4.7 Each association should be depicted in at least one UML class diagram

Associations should be depicted as UML associations.

Roles should be depicted with aggregation adornments, as appropriate. If the aggregation property of the role is true, the class diagram should depict the role as a diamond. If the multiplicity attribute is set to “composite” or “transient-composite,” the diamond should be filled in; otherwise the diamond should be hollow.

Roles should be depicted with role name adornments, as appropriate. If a given role is navigable, the role name adornment should be shown on the class diagram. The role name should be identical to the property term of the role.

Roles should be depicted with Multiplicity adornments, as appropriate. The multiplicity adornment should always be displayed, unless the multiplicity has a value of “composite”. The UML multiplicity should be the same as the multiplicity defined in the Data Dictionary and Data Registry, except for “transient-composite,” which has a UML multiplicity of “0..1”

Roles may be depicted with navigation adornments (i.e. an open arrow).

A note may be depicted in any class diagram. These can be useful in providing additional information to the reader.

Constraints may be depicted.

E.4.8 Tables should be defined as a pair of associated object classes

A logical table should be defined using a table object class that provides information about the table contents and an associated entry object class that defines the contents of each record within the table.

The contents of a table, i.e., the entries, may be accessed by multiple table object classes. Each access path should identify the key used to identify specific entries in a table.

E.4.9 Other guides on developing data (independent of modeling)

E.4.9.1 Property rules

The naming and semantics of a property should be general enough to allow use of the property with more than one object class since a property is not restricted to a single object class. The naming and semantics should also be general enough to allow use of the property with more than one value domain, since a property is not restricted to a single value domain.