PUBLICLY AVAILABLE SPECIFICATION

ISO/PAS 16917

First edition
2002-12-15

Ships and marine technology — Data transfer standard for maritime and intermodal transportation and security

Navires et technologie maritime — Norme de transfert de données pour le transport maritime, le transport intermodal et la sécurité

Reference number
ISO/PAS 16917:2002(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/PAS 16917 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 10, *Computer applications*.

0 Introduction

0.1 Background

The need to exchange data in electronic form is recognized throughout industry and government. This need has been driven by specific business requirements and has resulted in the initiation of many data-transfer standards. The transportation industry is particularly dependent on the efficient exchange of information among the many participants. These data-transfer requirements cover both the transportation assets needed to perform the transportation as well as commercial information on the cargo transported. To that end, a number of parallel efforts are underway to promote data exchange by way of standards organizations, the United Nations and trade associations. The need to exchange data relative to cargo, ship, intermodal transport, and port security gives urgency to the establishment of an applicable data-transfer standard.

Data-transfer standards and schema have been built around the models of specific business processes and have identified specific data sets requiring exchange. Many of these specific commercial requirements were met by EDI data messages. The exchange of specific technical data for the building of ships is being addressed by STEP (ISO 13303) standards. These standards embed the data definitions in the software, limiting the flexibility for use in other applications. EDI and STEP require the implementation of costly complex software. Both are primarily implemented by large organizations with their trading partners. Worldwide data exchange, including small to medium enterprises, will require low-cost, flexible, Internet-based data-transfer methods. The implementation of new methods will incorporate common data definitions across all systems and will not limit the continued use of EDI or STEP.

New requirements include broad searches of business and security-related data and the ability to link a particular data item to many other data items located in diverse databases. Clearly, the ability to meet new business and government data-transfer needs will require some standard identification of the data elements. The Internet will play a crucial role in data exchange; however, the current primary limitation is a lack of common understanding on the meaning of the data. Therefore, data definitions relative to specific domains must be developed by industry groups with knowledge of the requirements. These Data Dictionary definitions, which may record other locations of the data, may then be linked to participating organization's databases. It does not require any organization to change the format of their own data but allows them to map to the standard Data Dictionary definition to facilitate data exchange.

Advancement in data-transfer technology results in changes in transfer documents and techniques. The separating out of the relatively stable data definitions from the changing data-transfer technology will facilitate the implementation of the new technology.

The data-exchange requirements may start with the building and operation of the equipment involved, from ships to container transport to port facilities. The commercial operation of the equipment requires even larger amounts of data exchange, including cargo documentation and the operation of the transportation equipment and terminals. Governments require the exchange of information concerning the safety of personnel and the environment, as well as the rapid analysis of transportation data to identify potential security risks.

Throughout the whole transportation process, the exchange of information is necessary among all the segments including

— building and operation of ships and equipment,

— building and operation of cargo containers and related equipment,

— building and operation of ports and terminals,

— tracking of cargo and containers (cargo visibility),

— exchange of commercial documents (shippers, brokers, carriers),

— e-commerce in support of transportation (chartering, provisions, bunkers, services),

— monitoring ship and cargo movements, including security checks of cargo, ships, and personnel, and

— collection of customs duties and port dues.

Each of these segments of the transportation process has developed data-exchange procedures to serve their own needs. Their systems were not designed to exchange data with external organizations. Even when the same basic transfer technology was used, the data is recorded in a different manner. World events now require the ability to exchange data across all segments. This Publicly Available Specification addresses the basic requirements to accomplish this using current international standards and without the need to change existing databases.

0.2 Purpose of ISO 16917

The purpose of this Publicly Available Specification is to facilitate the efficient transfer of data between various organizations involved with maritime and intermodal transportation and security. Transportation-security information requires an even wider access to data including trucks, trains and air shipment. This Publicly Available Specification will provide a method of linking databases on a worldwide basis so that data may be exchanged from computer to computer without manual intervention or need to change the way the data is stored. This Publicly Available Specification does not propose to define the commercial or government documents used in international trade, as a number of standards under development address this requirement. This Publicly Available Specification defines data elements in clear concise terms that can be used in multiple-data-transfer documents and to define the data elements in Data Dictionaries in a standardized way separate from the transfer documents. It will also define how the data dictionaries will be structured and maintained and how they may be used to link similar data around the world. The data-transfer may apply to the data exchange in the normal course of maritime business for both commercial and military transportation or to the collection and exchange of data in the security process from many diverse databases around the world. The data search and transfer process should be efficient and low cost with access through the Internet, along with a method of linking databases with different data structures by mapping to common data elements located in data dictionaries.

0.3 Description of ISO 16917

ISO 16917 is a Publicly Available Specification for the definition and structuring of meaningful data that is required to be readily exchanged in the maritime and intermodal transportation process. The meaning and structure of the data will be defined to a level that allows electronic exchange without the need for manual validation. The data elements will be defined in data dictionaries representing specific business domains. Data-transfer will be accomplished using some data-transfer messaging protocol (i.e. EDI, STEP/EXPRESS, XML). A Reference Data Library consisting of Data Dictionaries of metadata required in specific domains will be defined. Reference linking will be provided between data defined in Domain Data Dictionaries. This Publicly Available Specification will include a common method of indexing, structuring, and linking the data using a data model for both the data dictionary and the business domain, and it will support the exchange of data for the life cycle of the transportation equipment and its commercial use. This Publicly Available Specification makes reference to ISO/IEC 11179 and uses this International Standard as the basis for the data dictionaries.

This Publicly Available Specification describes four elements:

a) definition of the data in a standard form (Data Dictionaries), see Clause 4;

b) modeling of the data for reference indexing and searching (e.g. XML modeling and Topic maps), see Clause 5 and 6;

c) method of mapping data to other instances of the same data (e.g. Topic maps), see Clause 6;

d) electronically transmitting the data between computer systems incorporating rapidly evolving XML and EDI standards and dialects, see Clause 7.

Ships and marine technology — Data transfer standard for maritime and intermodal transportation and security

1 Scope

This Publicly Available Specification specifies a representation of information associated with the surface (marine, highway, rail) transportation of cargo and personnel. It supports the following:

— definition of information required to be exchanged in the building and operation of transportation equipment throughout its life cycle (see Figure 1);

— definition of information required to be exchanged in the commercial operation of transportation equipment and the movement of cargo (see Figure 2).

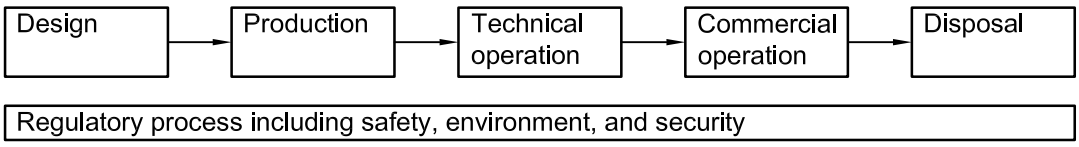

Figure 1 — Transportation equipment life cycle

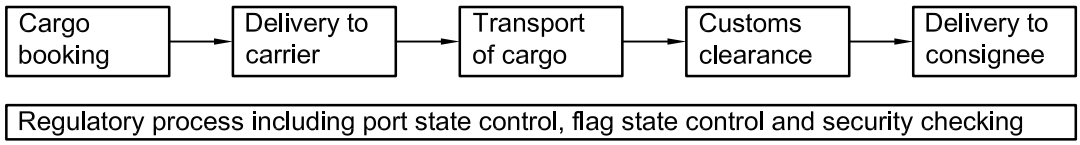

Figure 2 — Cargo transportation process

This Publicly Available Specification identifies the information that may be exchanged in both the production and operation of the assets needed in the transportation process as well as the information needed in the commercial transportation process and the regulatory information relating to each. Asset procurement and operation, as well as commercial transactions, are needed to support international trade. Continuous exchange of information between the equipment operators and the commercial operators are part of the transportation process. The above diagrams show the various processes and stages involved with maritime and intermodal transportation requiring data exchange.

This Publicly Available Specification is applicable to the implementation of databases and data warehouses that enable data sharing among the various participants in the transportation process.

The purpose of the Data Dictionary definitions is to allow the mapping of data that relates to the base definitions, with multiple occurrences of the data within industry and government databases.

2 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 11179 (all parts), *Specification and standardization of data elements*

3 Terms and definitions

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

3.1 General terms and abbreviations

3.1.1
EDI
Electronic Data Interchange

3.1.2
STEP
standard for exchange of product model data according to ISO 10303

3.1.3
Data-Transfer Document
set of data elements in some standard protocol (EDI, XML, etc.)

3.1.4
XML
extensible markup language

3.2 Terms taken from ISO/IEC 11179-1:1999

NOTE Certain terms have been adapted.

3.2.1
attribute
characteristic of an **object** or **entity**

3.2.2
attribute value
representation of an instance of an **attribute**

3.2.3
certified data element
recorded data element that has met the quality requirements specified in ISO/IEC 11179

3.2.4
classification scheme
arrangement or division of **objects** into groups based on characteristics that the **objects** have in common, e.g. origin, composition, structure, application, function, etc.

3.2.5
classification scheme item
discrete components of content in a **classification scheme**

NOTE These may be the nodes of a **taxonomy**/ontology, the terms of a **thesaurus**, etc.

3.2.6
classified component
administered component of a **data element** that may be classified in one or more **classification schemes**

NOTE These components include the **object class**, **property**, **representation class**, **data element concept**, **value domain**, and **data element**.

3.2.7
comments
remarks on the **data element**

3.2.8
concept
unit of thought constituted through abstraction on the basis of characteristics common to a set of **objects**

[ISO 1087:1990]

3.2.9
context
designation or description of the application environment or discipline in which a **name** is applied or from which it originates

3.2.10
data
representation of facts, concepts, or instructions in a formalized manner, suitable for communication, interpretation, or processing by humans or by automatic means

3.2.11
data dictionary
database used for **data** that refers to the use and structure of other **data**; that is, a database for the storage of **metadata**

[ANSI X3.172-1990]

See also **data element dictionary**.

3.2.12
data element
unit of **data** for which the **definition**, identification, **representation**, and permissible values are specified by means of a set of **attributes**

3.2.13
data element concept
concept that can be represented in the form of a **data element**, described independently of any particular **representation**

3.2.14
data element dictionary
information resource that lists and defines all relevant **data elements**

See also **register**.

3.2.15
data element facet
any aspect of a **data element** that is subject to classification

NOTE This includes object class, property, representation, and data element concept.

3.2.16
data element name
single or multi-word designation used as the primary means of identification of **data elements** for humans

3.2.17
data element registry
information resource kept by a **registration authority** that describes the meaning and representational form of **data elements**, including registration **identifiers**, **definitions**, **names**, **value domains**, **metadata** and administrative **attributes**, etc.

See also **register**.

3.2.18
data element value
value out of a set of permissible values pertaining to a **data element**

See also **data value**.

3.2.19
data identifier
DI
identifier of a **data element** (a string of characters or other graphic symbols) assigned by a **registration authority**

3.2.20
data item
one occurrence of a **data element**

3.2.21
data model
description of the organization of **data** in a manner that reflects an information structure

3.2.22
data steward
person or organization delegated the responsibility for managing a specific set of **data** resources

3.2.23
datatype
format used for the collection of letters, digits, and/or symbols, to depict values of a **data element**, determined by the operations that may be performed on the **data element**

3.2.24
datatype of data element values
set of distinct values for representing the **data element value**

3.2.25
data value
element of a **value domain**

3.2.26
definition
word or phrase expressing the essential nature of a person or thing or class of persons or things: an answer to the question "what is x?" or "what is an x?"; a statement of the meaning of a word or word group [Webster's Third New International Dictionary of the English Language Unabridged, 1986]. Statement that expresses the essential nature of a **data element** and permits its differentiation from all other **data elements**

3.2.27
domain
set of possible **data values** of an **attribute**

[ISO/IEC 2382]

See also **value domain**.

NOTE Also can refer to a business domain.

3.2.28
entity
any concrete or abstract thing of interest, including associations among things

[ISO/IEC 2382]

See also **object class**.

3.2.29
enumerated domain
value domain that is specified by a list of all permissible values

3.2.30
form of representation
name or description of the form of **representation** for the **data element**, e.g. 'quantitative value, 'code', 'text', 'icon'

See also **representation term**.

3.2.31
identifier
language independent unique identifier of a **data element** within a **registration authority**

See also **data identifier**.

NOTE This is an unambiguous name for an **object** within a given context.

3.2.32
information
〈In information processing〉 knowledge concerning **objects**, such as facts, events, things, processes, or ideas, including **concepts**, that within a certain **context** has a particular meaning

[ISO/IEC 2382]

3.2.33
information interchange
process of sending and receiving **data** in such a manner that the **information** content or meaning assigned to the **data** is not altered during the transmission

3.2.34
international registration data identifier
IRDI
internationally unique **identifier** for a **data element**

3.2.35
keyword
one or more significant words used for retrieval of **data elements**

3.2.36
layout of representation
layout of characters in **data element values** expressed by a character string representation

3.2.37
lexical
pertaining to words or the vocabulary of a language as distinguished from its grammar and construction

3.2.38
maximum size of data element values
maximum number of storage units (of the corresponding **datatype**) to represent the **data element value**

3.2.39
metadata
data that defines and describes other **data**

3.2.40
minimum size of data element values
minimum number of storage units (of the corresponding **datatype**) to represent **the data element value**

3.2.41
name
primary means of identification of **objects** and ideas for humans; a single or multi-word designation assigned to a **data element**

3.2.42
object
any part of the conceivable or perceivable world

[ISO 1087:1990]

3.2.43
object class
set of **objects**: a set of ideas, abstractions, or things in the real world that can be identified with explicit boundaries and meaning and whose **properties** and behaviour follow the same rules

3.2.44
object class term
component of the **name** of a **data element** which represents the **object class** to which it belongs

EXAMPLE Employee

3.2.45
permissible data element values
set of representations of permissible instances of the **data element**, according to the representation form, layout, **datatype**, **maximum size**, and **minimum size** specified in the corresponding **attributes**

NOTE The set can be specified by **name**, by reference to a source, by enumeration of the representation of the instances, or by rules for generating instances.

3.2.46
property
peculiarity common to all members of an **object class**

3.2.47
property term
component of the **data element name** which expresses a **property** of an **object class** (a component of the **name** of a **data element** which expresses the category to which the **data element** belongs)

3.2.48
qualifier
term that helps define and render a **concept** unique

3.2.49
qualifier term
word or words which help define and differentiate a **name** within the database

3.2.50
recorded data element
submitted **data element** which contains all mandatory **attributes** and has been recorded but the contents may not meet the quality requirements specified in this International Standard

3.2.51
register
set of files (paper, electronic, or a combination) containing the assigned data elements and the associated information

See also **data element registry**.

3.2.52
registration
assignment of an unambiguous **identifier** to a **data element** in a way that makes the **metadata** about those **data elements** available to interested parties

3.2.53
registration applicant
organization, individual, etc., which requests the assignment of an **identifier** from a r**egistration authority**

3.2.54
registration authority
RA
organization authorized to register **data elements** or other **objects**

3.2.55
registration authority identifier
RAI
identifier assigned to a **registration authority**

3.2.56
registration status
designation of the position in the **registration** life-cycle of a **data element**

3.2.57
related data reference
reference between a **data element** and any related **data**

3.2.58
representation
combination of a **value domain**, **datatype**, and, if necessary, a unit of measure or a character set

3.2.59
representation category
type of symbol, character, or other designation used to represent a **data element**

3.2.60
representation term
component of a **data element name** which describes the **form of representation** of the **data element**

3.2.61
responsible organization
organization or unit within an organization that is responsible for the contents of the mandatory **attributes** by which the **data element** is specified

3.2.62
semantics
branch of linguistic science which deals with the meaning of words (Webster)

3.2.63
separator
symbol or space enclosing or separating components within a **name**; a delimiter

3.2.64
standardized data element
certified data element within the **data element registry** that is preferred for use

3.2.65
structure set
method of placing **objects** in **context**, revealing relationships to other **objects**

EXAMPLES Entity-relationship models, **taxonomies**, and ontologies.

3.2.66
submitting organization
SO
organization or unit within an organization that has submitted the **data element** for addition, change, cancellation, or withdrawal in the **data element registry**

3.2.67
synonymous name
single or multi-word designation that differs from the given **name**, but represents the same **data element concept**

3.2.68
syntax
structure of expressions in a language, and the rules governing the structure of a language; the relationships among characters or groups of characters, independent of their meanings or the manner of their interpretation and use

3.2.69
taxonomy
classification according to presumed natural relationships among types and their subtypes

3.2.70
term
designation of a defined concept in a special language by a linguistic expression

[ISO/IEC 1087:1990]

3.2.71
thesaurus
controlled vocabulary arranged in a given order in which relationships among terms are displayed and identified

3.2.72
type of relationship
expression that characterizes the relationship between the **data element** and related **data**

3.2.73
value domain
set of permissible values

3.2.74
version
identification of an issue of a **data element** specification in a series of **evolving data element** specifications within a **registration authority**

3.2.75
version identifier
VI
identifier assigned to a **version** under which a data element registration is submitted or updated

4 Data Dictionary (ISO/IEC 11179)

4.1 Purpose

The Data Dictionary is a repository of metadata for a particular business domain that describes the data elements that are normally exchanged within the particular business domain. The Data Dictionary shall describe the data element to a level that will allow it to be incorporated into a data-transfer document for computer-to-computer exchange. This will require definition in unambiguous terms. The data-elements description will include other information that will provide links to similar or identical data in remote databases.

4.2 Data Dictionary Standard

ISO/IEC 11179 describes the necessary structure of the data to be used in a data dictionary. Further information related to the background and purpose of ISO/IEC 11179 is given in informative Annex A.

5 Data modelling

5.1 General

The data dictionary is a database of data that refers to the use and structure of other data (metadata). A data model is a description of the organization of data in a manner that reflects the information structure. It is necessary to organize the data in the data dictionary to make it accessible as well as use the data for various applications and exchange the data. There are a number of conventions to model data. The following gives a general description and example of data modelling (another method is described in ISO 13584-42, PLIB).

5.2 Data model for data dictionary

The data dictionary will be developed from a data model that is based on and uses the terminology and concepts contained in ISO 11179. This data-dictionary data model (or metamodel) will proscribe a representation for the ISO 11179 concepts and add the necessary contextual relationships between these representations. This model is an expression of the metadata-management requirements to support the definition and interchange of maritime and intermodal transportation data required to improve the transportation process and international security postures. This metamodel will be constructed to be independent of any particular physical implementation and capture the pertinent relationships between metadata to allow update and modification of that data without introducing data anomalies or impairing data integrity.

The most fundamental units of structure for an ISO 11179-compliant metamodel are classes and properties. Brief descriptions of a class and a property are given below, and an example of their representation in a metamodel is shown in Figure 3.

A class is a set of object types with a common structure and behaviour. Classes are organized into a hierarchy (sub-type and super-type classes). Each class may have zero or more applicable properties. Hierarchies must be flexible to admit new classes and the editing of existing classes with minimum effort.

A property is an attribute or aspect of a class's members that can be described as a data value. Properties are inherited downwards through the class hierarchy.

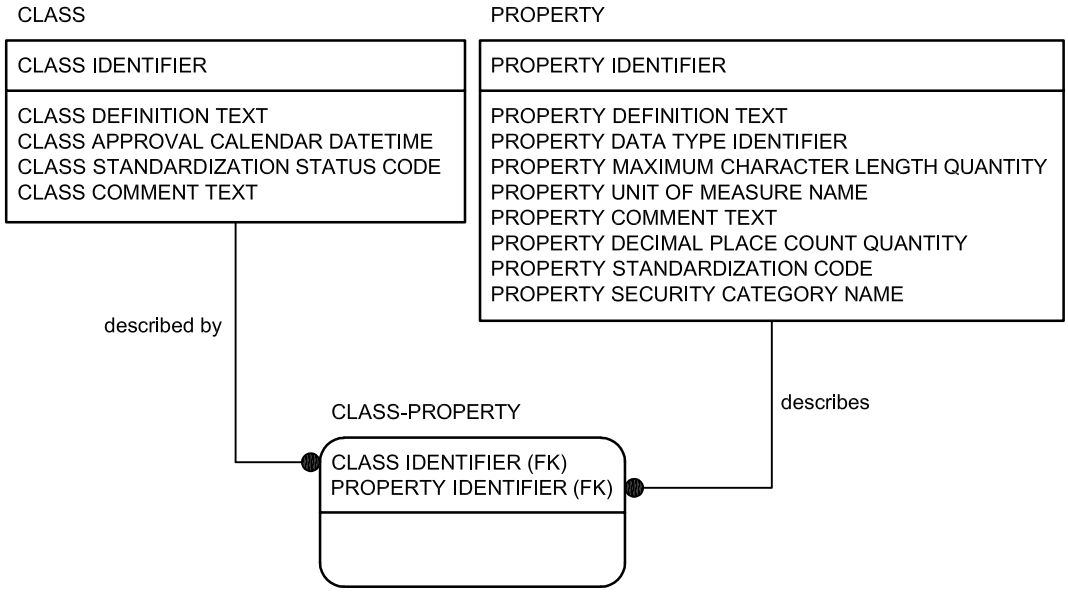

Figure 3 — Illustration of an ISO 11179-compliant metamodel

5.3 Data models for the application domain

5.3.1 Normalized business model

This model describes the relationships between the data generated by the application domain, in this case the marine and intermodal transportation of goods. (The same procedures apply as well to the production of transportation assets.) It uses the same methodology as that used to construct the metamodel. It provides the data relationships and business rules of the data supporting the application domain process, and is a necessary prerequisite to the initial construction and logical expansion of subsequent models describing data transfer within the application-domain. Constructs in this model will be entered in the data dictionary so that application-domain metadata is available for discovery and use by all participants in the maritime and intermodal security process. The representation of properties in this model will form the basis of the transfer data model described in 5.3.2. An example of a portion of this application-domain model is shown in Figure 4.

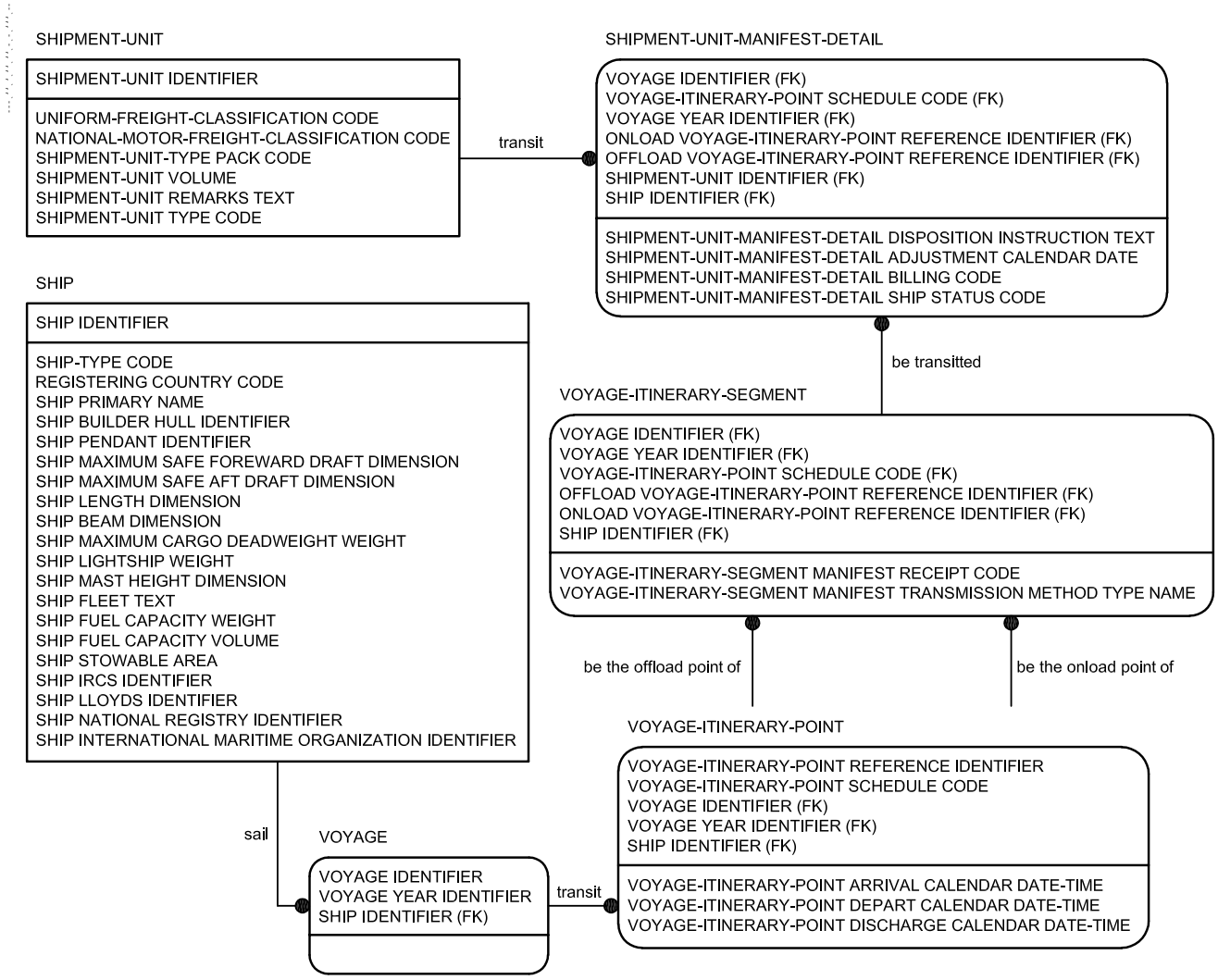

Figure 4 — Example of a portion of application-domain model

5.3.2 Data-transfer data model

This data model primarily describes the data-transfer documents, which are made up of data elements contained in the domain data model and whose metadata is contained in the Data Dictionary. Depending on the complexity and amount of data to transfer, this model may be as simple as an XML document schema. The data model is maintained as an XML schema and produces data-transfer documents in an XML format. The data model for this Publicly Available Specification will be developed in a generic way such that any groups of classes and properties could be integrated together as an “exchange model”, instantiated with data values and transferred as an XML exchange file. This methodology will ensure that the data model remains stable while the dictionaries and ontologies could evolve. The main advantage of using such a technique is to save in resources needed for the development of the data-exchange interface. This can be realized by virtue of having a generic data model that will not change over time and, as such, will not require continuous upgrading of the data-exchange interfaces. However, the data dictionaries could change with time according to future new requirements of the business. A change in dictionaries will not involve a major change to data-exchange interfaces. However, as data-transfer methods, protocols and formats evolve due to changes in business processes and the adoption of newer technologies such as wireless communications, the data dictionaries must reflect the changed practices. An example of selected data from the application model in 5.3.1 that meets the transfer requirements of a “Ship Manifest” is shown in informative Annex B in XML Schema format.

The main structure of the data model will be to enable references to the compliant dictionaries via generalized and flexible data-modelling constructs. This characteristic provides both flexibility and a mechanism by which very specialized constructs (e.g. "container", "security data" and so on) can be described at implementation level.

It is intended that this generic model will allow the exchange of any property, either individually or as a group. Also, the choice of any class or property will be left to the end-user and would be decided by those who want to exchange data. In other words, this Publicly Available Specification on its own will not dictate any particular exchange scenario or its contents.

6 Linking Data Architecture

6.1 General

When deciding to link large amounts of data on a worldwide basis, there must be a formalized method to seek out and identify the data. One method is using a semantic network, which has a structure of nodes and links. The nodes represent objects or concepts within a specific domain. The links define relationships between the nodes. Topic Maps are shown as one method of providing this linking capability.

6.2 Topic Map

Topic Map formalism (see ISO/IEC 13250) can be used to represent the information contained within the data dictionary. Topic Maps provide an ideal formalism for representing information in a complex environment. A Topic Map essentially serves as an index to data, metadata, information, and analysis within a domain. It allows for definition of topics (subjects), occurrences (resources), descriptions of those resources, complex relationships between resources, and context through scope.

NOTE There are now commercially available tools for authoring and navigation of Topic Maps. A Topic Map developed for a specific domain/application such as cargo security and supporting infrastructure, would facilitate building and maintenance of the data dictionary as well as providing search and analysis capabilities.

7 Data-Transfer Architecture

Figure 5 shows the architecture of the data-transfer standard. User applications access the Data Search and Transfer Software. Data to be acquired from a remote database is first identified in a Domain Data Dictionary. The Dictionary is structured within a Topic Map that provides the link to any registered occurrences of the data in participating databases. The Data Search Software will create a data-search message based on the standard XML protocol obtained from the Data Dictionary. This may remain in XML format or be converted to any other format, such as an EDI format.

For transmitting data messages to external organizations, the user would again search the Data Dictionary to identify the required data elements and format and use this with the user's data-transfer software.

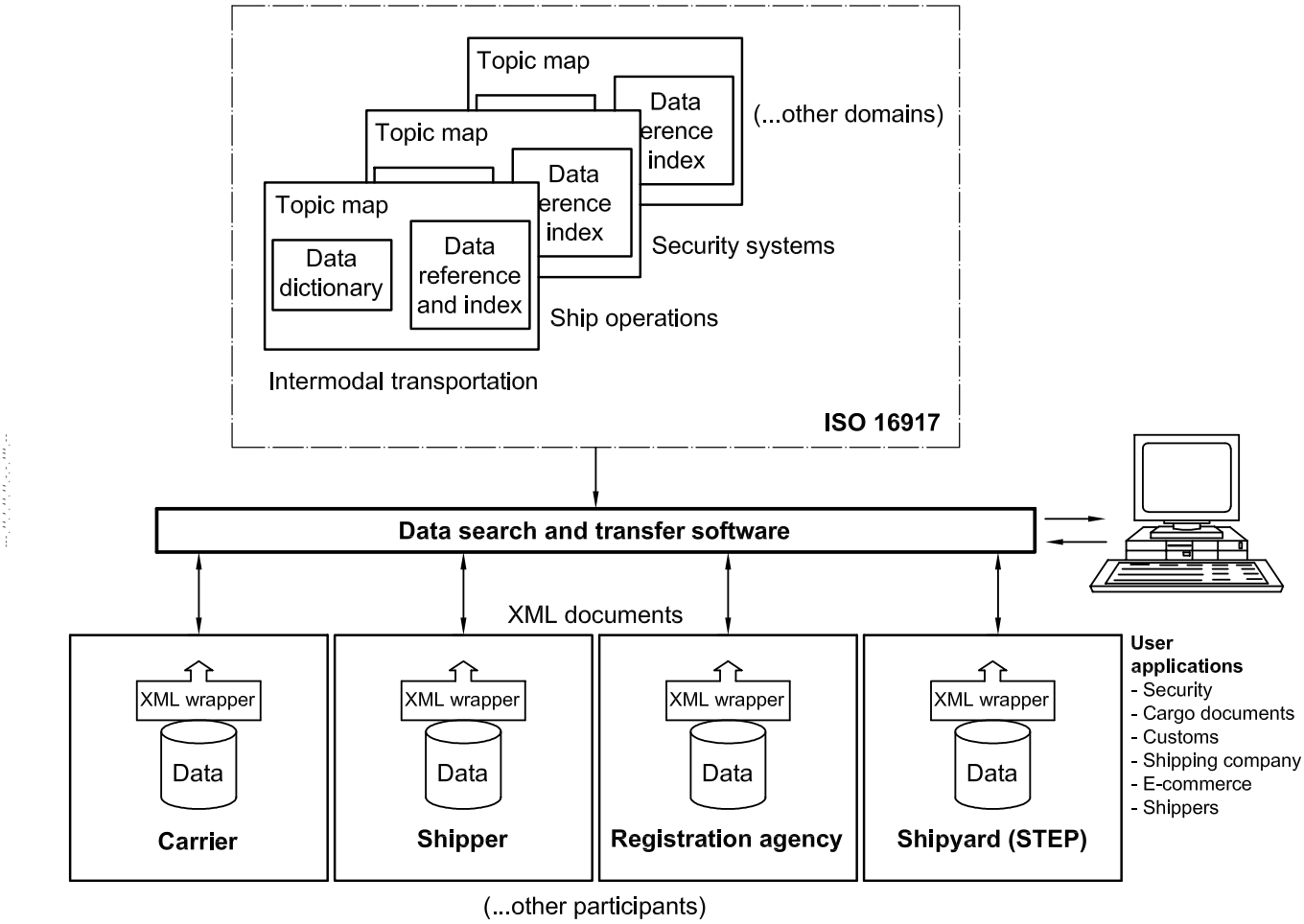

Figure 5 — Architecture of data-transfer standard

8 Data-Dictionary Development and Support

8.1 Data-Dictionary Development

Each data dictionary is to be developed by experts representing a specific domain.

8.2 Data-Dictionary Maintenance

Data Dictionaries are to be implemented and maintained by Industry Domain Groups who have a specific interest and knowledge of the data definitions.

8.3 Data-Element Registration

Data elements/objects has to employ registration techniques to insure unambiguous identification.

8.4 Place of Data Register

Registration is to be maintained on an Internet website.

Annex A
(informative)

Further information related to background and purpose of ISO/IEC 11179

A.1 Background

Humans are aware of anything that exists in the natural world through its properties. Data represents the properties of these things. Specification of data elements, the basic units of data, involves documenting relevant characteristics of each data element to ensure that its representation of the natural-world item is consistent and accurate. Data that has been carefully specified and standardized greatly enhances its usefulness and shareability across systems and environments. Sharing data involves the ability to locate desired data, retrieve the data, and to exchange the data with others. When data elements are well documented according to ISO/IEC 11179 finding and retrieving them from disparate databases, as well as sending and receiving them via electronic communications, are made easier.

The recognition and standardization of data elements used in communications through automated information-processing systems is an ongoing and essential activity. The success of this activity and its application throughout the world is of vital importance if international communications among governments, businesses and scientific communities are to be improved.

The primary data sharing and standardization problems addressed by the development of this International Standard include, but are not limited to, the following.

— A lack of mechanisms for enabling global data acquisition and interchange, particularly across application areas.

— It is currently impossible to correlate the rapidly increasing number of data identifiers due to the increased computer use of computer communications internationally, the rapid proliferation of XML “standards” for specific business domains, and the need to incorporate new data related to advanced technologies and improved business processes.

— Unique global identifiers for standard data elements currently do not exist.

— Documentation of data-element characteristics is inadequate to support fully automated sharing of data, including locating, retrieving and exchanging the data.

— Finding and retrieving a specific standard data element among thousands or millions is difficult or impossible.

— No universal means for organizing standard data elements exists.

— While data is sometimes standardized within an organization, there are few common data standards between organizations.

— Exchange of data among organizations results in a proliferation of customized data-interchange representations.

— Data definitions and descriptions are not sufficiently precise to support reuse or multiple users of data.

— Current inventory structures for reducing logical data redundancies are inadequate.

— Global implementation of Electronic Data Interchange (EDI) is impeded by a lack of standard data elements; standard data elements are needed for the content and format of EDI messages.

To facilitate global electronic communications, the International Standards community has been working diligently to define an Open Systems Interconnection Environment (OSIE) within which diverse computer hardware and applications could share information. Standards have been proposed or defined for three (hardware, software, and communications) of the four (hardware, software, communications, and data) basic components required for open information-processing systems. ISO/IEC 11179 for data specification, the fourth basic component for open information systems, provides a mechanism for enabling data to be shared in the OSIE.

For systems to be truly open, data must be portable and shareable within and among these various application environments, which span localized and distributed networks. For data to be shareable, both the users and owners of data must have a common understanding of its meaning, representation and identification. To understand the meaning of any data, the descriptions of the data must be available to the users. Data must be adequately described and users must have a convenient way to obtain these descriptions. There must be a way to organize the content and representation of the data, so that data descriptions are consistent and can be easily located by data designers and users. Uniform specification of data facilitates data retrieval, data exchange, and consistent use of data throughout the Software Development Life Cycle. The units of information with normalized meanings and formats are known as "standardized data elements."

A.2 Purpose

ISO/IEC 11179 describes the standardizing and registering of data elements to make data understandable and shareable. Data-element standardization and registration as described in ISO/IEC 11179 allow the creation of a shared data environment in much less time and with much less effort than it takes for conventional data-management methodologies.

The purpose of this multi-part International Standard is to give concrete guidance on the formulation and maintenance of discrete data-element descriptions and semantic content (metadata) that shall be used to formulate data elements in a consistent, standard manner. It also provides guidance for establishing a data-element registry.

Although motivated by the desire for the open exchange of data throughout the international communities by electronic information interchanges, this International Standard

— facilitates acquisition and registration of data,

— expedites access and use of data,

— simplifies data manipulation by intelligent software by enabling manipulation of data based on characteristics described by metadata,

— enables the development of a data representation metamodel for CASE tools and repositories, and

— facilitates electronic data interchange and data sharing.

This International Standard benefits the communication of data among information systems and people.

— within an organization,

— among different organizations, and

— crossing all levels of software and hardware, and geographic, organizational, political and human-language boundaries.

Metadata about data elements is stored in a data-element registry. A data-element registry supports data sharing with descriptions of data. Registration is the process of documenting metadata to support data shareability. Registration should be carried out at the data-element level to promote and maximize semantic value. This International Standard enables the end user to interpret the intended meaning confidently, correctly and unambiguously.

Annex B
(informative)

Data-transfer data model

An example of selected data from the application model in 5.3.1 that meets the transfer requirements of a “Ship Manifest” is shown below in XML Schema format:

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="SHIP">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="SHIP_IDENTIFIER">
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:maxLength value="6"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:element>
        <xs:element name="SHIP_INTERNATIONAL_MARITIME_ORGANIZATION_IDENTIFIER">
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:maxLength value="10"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:element>
        <xs:element ref="VOYAGE" minOccurs="1" maxOccurs="1"/>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

  <xs:element name="VOYAGE">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="VOYAGE_IDENTIFIER">
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:maxLength value="4"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:element>
        <xs:element name="VOYAGE_YEAR_IDENTIFIER">
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:maxLength value="4"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

  <xs:element name="SHIPMENT-UNIT">
    <xs:complexType>
      <xs:sequence maxOccurs="unbounded">
```

```
            <xs:element name="SHIPMENT-UNIT_IDENTIFIER">
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:maxLength value="50"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="UNIFORM-FREIGHT-CLASSIFICATION_CODE">
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:maxLength value="50"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="SHIPMENT-UNIT_VOLUME" type="xs:integer"/>
            <xs:element ref="VOYAGE-ITINERARY-SEGMENT"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="VOYAGE-ITINERARY-SEGMENT">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="ONLOAD_VOYAGE-ITINERARY-POINT_REFERENCE_IDENTIFIER">
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:maxLength value="2"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="OFFLOAD_VOYAGE-ITINERARY-POINT_REFERENCE_IDENTIFIER">
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:maxLength value="2"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
    </xs:schema>
```

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ICS 35.240.60; 47.020.99

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