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Information container for linked document delivery — Exchange specification —

Part 1: Container

Conteneur d'informations pour la livraison de documents liés — Spécification d'échange —

Partie 1: Conteneur

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 13, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 442, *Building Information Modelling (BIM)*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 21597 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The ISO 21597 series has been developed in response to a recognized need within the construction industry to be able to handle multiple documents as one information delivery.

Information deliveries are often a combination of drawings, information models (representing built or natural assets in the physical world), text documents, spreadsheets, photos, videos, audiofiles, etc. Increasingly, this may also include datasets based on any ontology. An ability to specify relationships using links between information elements in those separate documents can contribute significantly to the value of an information delivery. The composition of such a package arises both from the requirements of the process, e.g. delivery of as-built information, and from the specific functional purpose e.g. performing a quantity take-off or communication about issues in 3D models.

In this document a specification is given for a container that stores documents, along with a means of linking otherwise disconnected data within those documents.

The container format includes a header file and optional link files that define relationships by including references to the documents, or to elements within them. The header file uniquely identifies the container and its contractual or collaborative intention. This information is defined using the RDF, RDFS and OWL semantic web standards.

The header file, along with any additional RDF(S)/OWL files or resources, forms a suite that may be directly queried by software. The link references may be interpreted by the recipient applications or reviewed interactively by the recipient. Where it includes link references into the content of documents that don't support standardized querying mechanisms, their resolution may depend on third party interpreters.

The format can also be used to deliver multiple versions of the same document.

Information container for linked document delivery — Exchange specification —

Part 1: Container

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This document defines an open and stable container format to exchange files of a heterogeneous nature to deliver, store and archive documents that describe an asset throughout its entire lifecycle.

It is suitable for all parties dealing with information concerning the built environment, where there is a need to exchange multiple documents and their interrelationships, either as part of the process or as contracted deliverables. The format is intended to use resources either included in the container (such as documents) or referenced remotely (such as web resources). A key feature is that the container can include information about the relationships between the documents. Relevant use-cases reflect the need for information exchange during the entire life cycle of any built asset and can include, but are not limited to, the handover of

1. a published bidding package,
2. required project deliverables at a specific project stage (e.g. when proposing different design scenarios),
3. shared information as background or for further development,
4. published approval packages, or
5. information about versions between partners to provide a means to reference particular states of the information and track changes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 21320-1, *Information technology — Document Container File — Part 1: Core.*

IANA. Internet Assigned Numbers Authority *Media Types*. [viewed 6 May 2019]. Available from: https://www.iana.org/assignments/media-types/media-types.xhtml

W3C-OWL2-SPEC. Motik B., Patel-Schneider P.F., Parsia B. eds. *OWL 2 Web Ontology Language: Structural Specification and Functional-Style Syntax (Second Edition)*. W3C Recommendation, 11 December 2012 [viewed July 22nd 2019]. Latest version available at http://www.w3.org/TR/owl2-syntax/

W3C-RDF11-CONCEPTS. Cyganiak R., Wood D., Lanthaler M. *RDF 1.1 Concepts and Abstract Syntax. W3C Recommendation*, 25 February 2014 [viewed July 22nd 2019]. Latest version available at http://www.w3.org/TR/rdf11-concepts/

W3C-RDF11-SCHEMA. Brickley D., Guha R.V. *RDF Schema 1.1*. W3C Recommendation, 25 February 2014 [viewed July 22nd 2019]. Latest version available at http://www.w3.org/TR/rdf-schema/

W3C-RDF11-XML. Gandon F., Schreiber G. *RDF 1.1 XML Syntax*. W3C Recommendation, 25 February 2014 [viewed July 22nd 2019]. Latest version available at http://www.w3.org/TR/rdf-syntax-grammar/

W3C-XML-DATATYPES. Peterson D., Gao S., Malhotra A., Sperberg-McQueen C.M., Thompson H.S. eds. (Version 1.1) and Biron P.V., Malhotra A. eds. (Version 1.0). *W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes*. W3C Recommendation, 5 April 2012 [viewed July 22nd 2019]. Latest version available at http://www.w3.org/TR/xmlschema11-2/

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
container
file that conforms to the ISO 21597 series

3.1.2
payload
primary information in the form of *documents* (3.1.3) that is included within the *container* (3.1.1)

Note 1 to entry: This does not include the header file (Index.rdf) or the *ontology* (3.1.7) *resource* (3.1.14) files.

3.1.3
document
fixed and structured amount of information that can be managed and interchanged as a unit between users and systems

Note 1 to entry: This unit may not necessarily be human perceptible. Information is usually stored on a data medium.

Note 2 to entry: Used in the ISO 21597 series to refer to any document that forms part of the *payload* (3.1.2) in the container, including any 2D or 3D models that represent built or natural assets in the physical world; these may be held in any standard or proprietary format.

3.1.4
internal document
document (3.1.3) located within the *container* (3.1.1)

3.1.5
external document
document (3.1.3) located outside the *container* (3.1.1)

3.1.6
link
relation between *documents* (3.1.3), including between elements in documents

3.1.7
ontology
specification of concrete or abstract things, and the relationships among them, in a prescribed domain of knowledge

Note 1 to entry: The specification should be computer processable.

Note 2 to entry: The definition is adapted from W3C-OWL2-SPEC.

3.1.8
container ontology
RDF(S)/OWL file providing the *object* (3.1.23) *classes* (3.1.15) and properties that shall be used to specify the contents of a *container* (3.1.1)

3.1.9
linkset ontology
RDF(S)/OWL file providing the *object* (3.1.23) *classes* (3.1.15) and properties that shall be used to specify *links* (3.1.6) between *documents* (3.1.3) in a *container* (3.1.1)

3.1.10
dataset
RDF(S)/OWL file that contains *individuals* (3.1.16) that comply with the *classes* (3.1.15) as specified by *ontologies* (3.1.7)

3.1.11
index dataset
RDF(S)/OWL file containing an index of the contents of the *container* (3.1.1)

3.1.12
link dataset
RDF(S)/OWL file containing *links* (3.1.6) as defined in the ISO 21597 series

3.1.13
serialisation
encoding of an *ontology* (3.1.7) or *dataset* (3.1.10) into a format that can be stored, typically in a file

Note 1 to entry: The definition is adapted from W3C-RDF11-XML.

3.1.14
resource
something in the world (the "universe of discourse") denoted by an IRI or literal

Note 1 to entry: Anything can be a resource, including physical things, *documents* (3.1.3), abstract concepts, numbers and strings; the term is synonymous with "entity" as it is used in the RDF Semantics specification.

Note 2 to entry: The definition is adapted from W3C-RDF11-CONCEPTS.

3.1.15
class
set of *individuals* (3.1.16) having the same characteristics

Note 1 to entry: The definition is adapted from W3C-RDF11-SCHEMA, 2.2.

3.1.16
individual
resource (3.1.14) that has been placed into any RDFS *class* (3.1.15) as an instance of that class

Note 1 to entry: Like RDF classes, every OWL class is associated with a set of individuals, called the class extension; the individuals in the class extension are the instances of the class.

Note 2 to entry: There are two types of individuals in the syntax of OWL 2. Named individuals are given an explicit name that can be used in any *ontology* (3.1.7) to refer to the same *object* (3.1.23). Anonymous individuals do not have a global name and are thus local to the ontology in which they are contained.

Note 3 to entry: The definition is adapted from W3C-OWL2-SPEC, 5.6.

3.1.17
object property
OWL property that links *individuals* (3.1.16) to other individuals

Note 1 to entry: The definition is adapted from W3C-OWL2-SPEC, 5.3.

3.1.18
datatype property
OWL property that can relate *individuals* (3.1.16) to literals

Note 1 to entry: Literals can be strings, numbers, date types, etc.

Note 2 to entry: The definition is adapted from W3C-OWL2-SPEC, 5.4.

3.1.19
namespace
group of identifiers for elements and attributes that are collectively bound to a URI such that their use will not cause naming conflicts

Note 1 to entry: The definition is adapted from W3C-RDF11-CONCEPTS, 1.

3.1.20
triple
statement in the form *subject-predicate-object* (3.1.21, 3.1.22, 3.1.23) that expresses a relationship between two *resources* (3.1.14)

Note 1 to entry: The definition is adapted from W3C-RDF11-CONCEPTS, 3.1.

3.1.21
subject
resource (3.1.14) (an IRI) about which a statement is made in the form of an RDF *triple* (3.1.20)

Note 1 to entry: This term, as used in the ISO 21597 series, is part of the RDF(S)/OWL vocabulary, where each triple consists of a subject, a *predicate* (3.1.22) and an *object* (3.1.23); a set of such triples is called an RDF graph.

Note 2 to entry: The definition is adapted from W3C-RDF11-SCHEMA, 5.3.2.

3.1.22
predicate
the relationship between a *subject* (3.1.21) and an *object* (3.1.23) in an RDF *triple* (3.1.20), also called a property

Note 1 to entry: The definition is adapted from W3C-RDF11-SCHEMA, 5.3.3.

3.1.23
object
resource (3.1.14) (either an IRI or a literal) assigned as the specified property of the *subject* (3.1.21) in a *triple* (3.1.20)

Note 1 to entry: This term, as used in the ISO 21597 series, is part of the RDF(S)/OWL vocabulary, where each triple consists of a subject, a *predicate* (3.1.22) and an object; a set of such triples is called an RDF graph.

Note 2 to entry: The definition is adapted from W3C-RDF11-SCHEMA, 5.3.4.

3.2 Abbreviated Terms

DBF	DataBase File
GIS	Geographic Information System
GML	Geography Markup Language
GUID	Globally Unique Identifier
ICDD	Information Container for linked Document delivery
IFC	Industry Foundation Classes
IRI	Internationalized Resource Identifier
OWL	Web Ontology Language
RDF	Resource Description Framework
RDFS	Resource Description Framework Schema
SHACL	Shapes Constraint Language
SPARQL	Simple Protocol And RDF Query Language
SQL	Structured Query Language
UML	Unified Modeling Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
W3C	World Wide Web Consortium
XML	eXtensible Markup Language
XSD	XML Schema Definition
XSLT	Extensible Stylesheet Language Transformations

NOTE IRI is an update of the URI released in 2005; while URIs are limited to a subset of the ASCII character set, IRIs can contain characters from the Universal Character Set (Unicode/ISO/IEC 10646). In the ISO 21597 series URIs and IRIs are used interchangeably.

4 Specifications

4.1 Use of RDF, RDFS and OWL constructs

All ontologies held in containers that conform to the ISO 21597 series shall be based on the languages RDF [W3C-RDF11-CONCEPTS], RDFS [W3C-RDF11-SCHEMA] and OWL [W3C-OWL2-SPEC] (referred to collectively in the ISO 21597 series as RDF(S)/OWL) and shall be serialized in RDF/XML [W3C-RDF11-XML] or any other equivalent RDF serialisation recommended by W3C.

It is expected that RDF(S)/OWL will be an important technology and a general platform for ontologies for the coming decades. Proprietary systems will increasingly adopt RDF(S)/OWL. However, to make the threshold for adoption of this document as low as possible, Annex C provides specifications to support the conversion of a container from RDF(S)/OWL to XSD/XML and vice versa.

In general, when used in the context of the world wide web, these languages use the following principles to support reasoning:

— Open world assumption - the truth of a statement is independent of whether it is known. In other words, not knowing that a statement is explicitly true does not imply that the statement is false.

— No unique names assumption - unless explicitly stated otherwise, it cannot be assumed that resources that are identified by different URIs are different.

The datasets that comply with the ontologies specified in the ISO 21597 series shall use the following interpretation of RDF(S)/OWL:

— Closed world assumption - a statement that is true is also known to be true; therefore, conversely, what is not formally specified in a container to be true, is false.

— Unique naming assumption - resources in a container that are identified with different URIs are considered to be different, unless explicitly declared as the same (using the *owl:sameAs* predicate).

Table 1 lists the RDF(S)/OWL constructs that are used in the ISO 21597 series and the interpretation to be used when validating the contents of a container. It is noted that, once the contents of the container has been validated, the data can be used in an open world context.

Table 1 — Listing of constructs used in the ISO 21597 series and their interpretation

Construct	Interpretation
owl:Class	In a dataset within a container, class membership for every individual shall be explicitly asserted, unless implicitly inferred using predicates such as *rdfs:subClassOf* [W3C-RDF11-SCHEMA, 3.4] or *owl:equivalentClass* [W3C-OWL2-SPEC, 9.1.2].
rdfs:subClassOf *rdfs:subPropertyOf*	The ISO 21597 series does not deviate from the W3C definitions [W3C-RDF11-SCHEMA]. Statements that may be inferred due to *rdfs:subClassOf* or *rdfs:subPropertyOf* statements shall be regarded as true even if not explicitly asserted. NOTE Statements where a class is mentioned are also true for any of its subclasses. Similarly, statements where a property is mentioned are also true for any of its sub properties.
owl:FunctionalProperty	The ISO 21597 series interprets *owl:FunctionalProperty* as a property with a maximum cardinality of 1. [W3C-OWL2-SPEC, 9.2.4]
owl:InverseFunctionalProperty	The ISO 21597 series interprets *owl:InverseFunctionalProperty* as an inverse property with a maximum cardinality of 1. [W3C-OWL2-SPEC, 9.2.7]
owl:equivalentClass	The ISO 21597 series does not deviate from the W3C definitions [W3C-OWL2-SPEC, 9.1.2]. Statements that may be inferred due to *owl:equivalentClass* statements shall be regarded as true even if not explicitly asserted.
rdfs:range *rdfs:domain*	These statements shall be interpreted as restrictions. It is invalid to have a subject or object of a statement (triple) in a dataset where that individual is a member of a class that does not comply with the *rdfs:range* or *rdfs:domain* declarations of the corresponding *owl:ObjectProperty* [W3C-OWL2-SPEC, 5.3] or *owl:DatatypeProperty* [W3C-OWL2-SPEC, 5.4]

