Technical Report

ISO/TR 22126-2

First edition
2025-01

Financial services — Semantic technology —

Part 2: OWL representation of the ISO 20022 metamodel and e-repository

Services financiers — Technologie sémantique —

Partie 2: Représentation OWL du métamodèle et du référentiel de l'ISO 20022

Reference number
ISO/TR 22126-2:2025(en)

© ISO 2025



COPYRIGHT PROTECTED DOCUMENT

© ISO 2025
All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Published in Switzerland

Contents

Page

Foreword ..... **v**

Introduction ..... **vi**

1 Scope **1**

2 Normative references **1**

3 Terms, definitions and abbreviated terms **1**
3.1 Terms and definitions 1
3.2 Abbreviated terms 2

4 Overview **2**
4.1 Graph transformations 2
4.1.1 General 2
4.1.2 Graphs derived from the XML document 4
4.1.3 Conversion to a FIX AE message 4
4.1.4 Graphs aligned with message and business components 4

5 Methods **5**
5.1 Multiple local RDF graphs 5
5.2 Open linked data 6

6 Reconciling differences between Ecore, RDF and OWL **7**
6.1 Introducing Ecore 7
6.2 Differences between Ecore and RDF standards 7
6.3 Separation of schema objects and instances 8
6.4 Python, pyecore and RDF 8
6.5 Ordering and structured data in RDF 9
6.5.1 General 9
6.5.2 Unordered relationships 9
6.5.3 RDF collections 9
6.5.4 RDF containers 10
6.5.5 Blank nodes and triples turned sideways 10
6.6 Internationalization in RDF 11
6.7 SHACL, another RDF schema language 11

7 Processing ISO 20022 instance messages in RDF **12**
7.1 The G_2 graph — Converting an ISO 20022 XML message to RDF instance data 12
7.2 Querying ISO 20022 message data with SPARQL 14
7.3 The G_1 graph — Maintaining ordering information 14
7.4 Compatibility with OWL and RDFS inference — G_4 graph 14
7.5 The G3 graph — Converting the auth.016 message to a FIX AE message 15

8 Mechanical conversion of the e-Repository **18**
8.1 File and namespace prefixes — M_C and B_C graphs 18
8.2 OrganisationIdentification — Business components and attributes 18
8.3 Message components and attributes 21
8.4 CodeSets 23
8.4.1 General 23
8.4.2 Empty CodeSet 23
8.4.3 CodeSet with codes 24
8.5 Coining unique identifiers 25
8.5.1 The problem 25
8.5.2 Composite names 25
8.5.3 Arbitrary disambiguators 25
8.5.4 External id 25
8.5.5 Internal id 26
8.5.6 Random id 26
8.5.7 Skolemization 26

© ISO 2025 – All rights reserved

9 Representing the ISO 20022 e-Repository in OWL and RDFS **26**
9.1 Methodology 26
9.2 RDFS modelling of a business component 28
9.3 Datatype and object properties in OWL 29
9.4 Representing enumerated types 30
9.5 Restrictions on data types 31
9.6 Disjoint classes 31
9.7 Miscellaneous objects and annotation properties 32
9.8 Containment relationships and inference 32
9.9 OWL inference and its limits 33
10 Instances aligned to the e-Repository **34**
10.1 The G_4 graph — Message expressed with message components 34
10.2 The G_5 graph — Abstract instance of a trade 35
10.3 Concepts missing in the business components 37
11 Conclusion **38**
Annex A (informative) **A preliminary OWL 2 ontology as a semantic model for ISO 20022** **40**
Bibliography **45**

© ISO 2025 – All rights reserved

Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 68, *Financial services*, Subcommittee SC 9, *Information exchange for financial services*.

A list of all parts in the ISO 22126 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.

© ISO 2025 – All rights reserved

Introduction

The purpose of this document is to demonstrate the feasibility and explore the design space for the representation of the ISO 20022 e-Repository in OWL DL, a decidable dialect of the OWL ontology language. This document demonstrates multiple representations of the auth.016 sample messages illustrating possible modelling choices.

The current e-Repository is constructed in a purpose-built system comprising multiple layers of object-oriented modelling built on the Eclipse Modeling Framework, a specialization of the Essential Meta-Object Facility (EMOF) standardized by the Object Management Group (OMG). This system can create class definitions and object instances in a computer language such as Java[1)] that serve as containers for data, but does not define the semantics, or meaning, of those objects. The EMOF model is a foundation to write software on (a "blank slate") but requires custom software to establish the meaning and behaviour of those objects.

In OWL DL, on the other hand, it is possible to construct concepts based on logical definitions. Although custom software can still be necessary, an OWL DL ontology has a meaning and defined behaviours when used with OWL standard tools. Out-of-the-box an OWL ontology works with ontology editors, reasoners and graph databases that allow queries with the SPARQL language. An OWL ontology can be used together with other OWL ontologies. Unlike more expressive systems such as ISO Common Logic, however, OWL DL is based on a subset of first-order logic that is decidable so that in addition to reasoning instances (for instance querying instances that match a logical definition) it can prove the consistency of an ontology. (As OWL is defined in terms of first-order logic, OWL axioms can be exported to other logic-based tools that can be more expressive, such as theorem provers, or more application-oriented, such as business rules engines.)

It is common for schemas and documentation for message families such as ISO 20022, FIX Protocol and SWIFT MT to be written in formats idiosyncratic to the family. Although ISO 20022 messages conform to an XML schema, authoritative definitions exist in the e-Repository as a set of Ecore-serialized objects specific to ISO 20022. The elements of FIX messages (which can be encoded in various wire formats) are defined in FIX Orchestra, an XML file which is specific to the FIX trading community. Tools designed to work with the schema of one standard do not natively work for other standards.

Applications that process financial messages have their own schemas that exist either explicitly or implicitly, for instance a set of tables, constraints, stored procedures and other projects in a relational database, or a hierarchy of classes in a programming language such as Java. Although disparate descriptions for the structure of messages and software systems fulfil the requirements of each system, technologists lack the global view necessary to take rapid and correct action.

To have that global view, it is desirable to bring schemas and instances from disparate systems into a single system which can be queried to support software development, make visualizations and do inference. RDF is a suitable framework for this: not only does it come with standard vocabularies such as RDFS, OWL and SHACL for representing schemas, but it can represent arbitrary data structures as a graph of nodes that possess datatype properties and are interconnected with object attributes. Some major features of RDF are:

a) the XML schema datatypes are available to represent common primitive data types that occur in general computing;

b) nodes and predicates, relationships between nodes, are named with URIs to establish a global namespace in which terms from arbitrary vocabularies can be combined;

c) text strings are tagged with ISO 639 language codes to provide a straightforward mechanism to represent labels and descriptions in multiple languages.

It is possible, as seen in Clause 7, to represent any kind of message in RDF through a simple form of mechanical translation – it possible in RDF to work without a schema of any kind. Clauses 9 and 10 demonstrate that, with more effort, it is possible to express the e-Repository and ISO 20022 messages as an OWL DL ontology.

1) Java is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

© ISO 2025 – All rights reserved

The EMOF form of the e-Repository is built in a number of layers starting from the M3 layer (the foundation of EMOF), the M2 layer (an object model used to describe the M1 model) and the M1 layer (definitions of business components, message components, etc.). Users of the e-Repository can create instances of objects defined at the M1 layer in the M0 layer that define individual messages or business objects. For the most part, the ontology is contained in the M1 layer and defined in terms of an idiosyncratic vocabulary defined in the M2 layer. This vocabulary is fit for purpose, but incompatible with other schema and ontology definition systems.

OWL DL requires a flatter organization where there is a clear separation between ontology objects (definitions of classes and properties) and instance objects (instances of the defined classes.) Most terminology from the M2 layer is replaced with terminology from the OWL standard, making the ontology automatically interoperable with other ontologies. Properties that cannot be expressed with built-in OWL properties, such as XML element names for the message components, are represented with annotation properties which, as defined in the ontology, not participate in inference. Objects in the e-Repository which are not naturally treated as class or property definitions are defined as instances in OWL DL with corresponding definitions derived from the M3 layer.

Users of this ontology can add additional instance and ontology objects. OWL, in particular, allows users to write logical definitions in terms of specific lists of objects, the attributes of objects and logical combinations such as AND, OR and NOT thereof. This makes it possible for a business or regulator to define a particular kind of transaction (a subclass) in terms of size, the time it took place, the security traded, the attributes of the organizations involved, etc. Annex A demonstrates that many categories defined and discussed in regulation and documents are straightforward to express in this manner, a significant step towards making business documents interpretable by machines.

© ISO 2025 – All rights reserved

Financial services — Semantic technology —

Part 2: OWL representation of the ISO 20022 metamodel and e-repository

1 Scope

This document is concerned with the representation of the ISO 20022 e-Repository contents in RDF and OWL by developing a case study around the ISO 20022 auth.016 sample message (hereafter simply referred to as "auth.016"). This includes:

a) transformation of the sample message into an RDF instance graph;

b) demonstrating a set of SPARQL rules that transform the auth.016 message into a FIX TradeCaptureReport(35=AE) message (hereafter simply referred to as "FIX AE");

c) expressing the metamodel, business components and message components exactly with a custom RDF vocabulary;

d) representing those schemas as OWL schemas using OWL vocabulary when possible and annotation properties otherwise;

e) creating instance graphs for the auth.016 sample messaging using the vocabulary of the business components and message components.

This document also discusses the choices that arise in structuring RDF documents equivalent to documents in XML, and FIX Tag-Value format balancing considerations such as preserving the order of parts of the message versus creating graphs that are suitable for RDFS and OWL inference.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

© ISO 2025 – All rights reserved