

INTERNATIONAL STANDARD

**ISO/IEC
21838-1**

First edition
2021-08

Information technology — Top-level ontologies (TLO) —

Part 1: Requirements



Reference number
ISO/IEC 21838-1:2021(E)

© ISO/IEC 2021



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2021

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	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Requirements for a top-level ontology	5
4.1 TLO as textual artefact	5
4.1.1 Overview	5
4.1.2 Relations between textual artefact and axiomatizations of the TLO	6
4.2 Axiomatization in the Web Ontology Language (OWL 2 with direct semantics)	6
4.2.1 General	6
4.2.2 Alternative OWL 2 Axiomatization	7
4.3 Axiomatization in a CL-conforming language	7
4.4 Supplementary documentation	7
4.4.1 Overview	7
4.4.2 Documentation of the purpose of the TLO	8
4.4.3 Documentation concerning demonstration of conformance of a domain ontology to the TLO	8
4.4.4 Documentation concerning consistency of the CL axiomatization	8
4.4.5 Documentation concerning the relation between OWL and CL axiomatizations	8
4.4.6 Documentation demonstrating breadth of coverage	9
4.4.7 Domain neutrality	13
4.4.8 Ontology management	13
5 Conformity	13
5.1 Overview	13
5.2 Ontology documentation	14
5.3 Supplementary documentation	14
Annex A (informative) Examples of ontology suites	15
Annex B (informative) The definition of ‘ontology’	16
Annex C (informative) Examples of documentation demonstrating breadth of coverage	19
Annex D (informative) Conformance of a domain ontology to a TLO	21
Bibliography	23

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 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 or www.iec.ch/members_experts/refdocs).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see patents.iec.ch).

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. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 32, *Data management and interchange*.

A list of all parts in the ISO/IEC 21838 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 and www.iec.ch/national-committees.

Introduction

This document was developed in response to the demand from many quarters for ontology-based solutions to the problem of semantic interoperability across networks of information systems. The demand arises particularly from large organizations and consortia of organizations in areas such as bioinformatics, healthcare, the manufacturing industry and military and government administration, where independently created information systems need to exchange data in such a way that meaning is preserved.

An ontology is on the one hand an artefact for human use, built out of terms and relations expressed using natural language. On the other hand, it is an artefact for use by computers, which requires that these terms and relations are captured in a formal language that is machine readable and has well-defined (typically, model-theoretic) semantics. Multiple languages have been developed for the purposes of ontology formalization, of which Common Logic (CL) and the Web Ontology Language (OWL) – specifically OWL 2 with direct semantics – are normatively referenced in this document.

An ontology can help to achieve sharing of meaning because its terms are associated with formal definitions specifying their meanings in a way that can be processed computationally. If an ontology can be shared across participating organizations, then data can be exchanged in such a way that meaning is preserved if the data can be associated with corresponding shared ontology terms.

CL and OWL 2 serve different ends. CL is a logical framework with the full expressivity of first-order logic (FOL), the unifying framework for all semantic web applications. Formalization in a language with the expressivity of FOL is required for the purposes of this document since weaker expressivity would not allow the ontology to capture in a formal way the implications of axioms in areas such as mereology and theories of location and change.

Formalization in a language like OWL 2 is needed, even though it is less expressive than CL, since it is decidable and this means that it can be used effectively by computer systems for purposes of logical reasoning and ontology quality assurance.

Where heterogeneous bodies of data need to be exchanged or manipulated, some have adopted approaches that involve the creation of a suite of ontologies incorporating a distinction of levels, with a single very general ontology at the top, governing one or more specific ontology modules at lower levels ([Annex A](#) provides examples). This document addresses the need that arises for those communities that have adopted such multi-level approaches. Specifically, its purpose is to specify what is required of a top-level ontology if it is to serve the needs of those building or re-engineering ontologies or other legacy systems at lower levels in a way that will support semantic interoperability among them.

To be fit for purpose, a top-level ontology needs to have appropriate content that is well documented and be available in machine-readable forms providing support for computational reasoning. This document specifies these requirements in terms of coverage, documentation and representation.

This is a preview - click here to buy the full publication

Information technology — Top-level ontologies (TLO) —

Part 1: Requirements

1 Scope

This document specifies required characteristics of a domain-neutral top-level ontology (TLO) that can be used in tandem with domain ontologies at lower levels to support data exchange, retrieval, discovery, integration and analysis.

If an ontology is to provide the overarching ontology content that will promote interoperability of domain ontologies and thereby support the design and use of purpose-built ontology suites, then it needs to satisfy certain requirements. This document specifies these requirements. It also supports a variety of other goals related to the achievement of semantic interoperability, for example, as concerns legacy ontologies developed using heterogeneous upper-level categories, where a coherently designed TLO can provide a target for coordinated re-engineering.

This document specifies the characteristics an ontology needs to possess to support the goals of exchange, retrieval, discovery, integration and analysis of data by computer systems.

The following are within the scope of this document

- Specification of the requirements an ontology needs to satisfy if it is to serve as a top-level hub ontology.
- Specification of the relations between a top-level ontology and domain ontologies.
- Specification of the role played by the terms in a top-level ontology in the formulation of definitions and axioms in ontologies at lower levels.

The following are outside the scope of this document:

- Specification of ontology languages, including the languages OWL 2 and CL, used in ontology development with standard model-theoretic semantics.
- Specification of methods for reasoning with ontologies.
- Specification of translators between notations of ontologies developed in different ontology languages.
- Specification of rules governing the use of IRIs as permanent identifiers for ontology terms.
- Specification of the principles of ontology maintenance and versioning.
- Specification of how ontologies can be used in the tagging or annotation of data.

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 24707, *Information technology — Common Logic (CL) — A framework for a family of logic-based languages*

WORLD WIDE WEB CONSORTIUM *W3C Recommendation* — *OWL 2 Web Ontology Language Document Overview* (Second Edition), <https://www.w3.org/TR/2012/REC-owl2-overview-20121211/>

WORLD WIDE WEB CONSORTIUM *W3C Recommendation* — *OWL 2 Web Ontology Language Direct Semantics*, <https://www.w3.org/TR/owl2-direct-semantics/>

WORLD WIDE WEB CONSORTIUM *W3C Recommendation* — *OWL 2 Web Ontology Language Structural Specification and Functional-Style Syntax* (Second Edition), <http://www.w3.org/TR/2012/REC-owl2-syntax-20121211/>