**Proposed Draft Technical Report**
**ISO/IEC PDTR 20943-6**

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**Title:** Information technology - Achieving metadata registry content consistency - Part 6: framework for building ontologies

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**Introductory note:**

The attached document is hereby submitted for a 3-month letter ballot to the NBs of ISO/IEC JTC 1/SC 32. The ballot starts 2011-07-20. No disposition of comments. This is the initial PDTR.

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Information technology — Procedures for achieving metadata registry content consistency — Part 6: Framework for generating ontologies
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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.

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/IEC TR 20943 consists of the following parts, under the general title Information technology — Procedures for achieving metadata registry content consistency:

— Part 1: Data elements
— Part 2: XML structured data
— Part 3: Value domains
— Part 4: Overview
— Part 5: Semantic Metadata Mapping Procedure
— Part 6: Framework for generating ontologies (this part)
Introduction

Semantic Web is a term defined by Tim Berners-Lee and recognized as an extension of the current web. The Semantic Web is an evolving extension of the World Wide Web that the semantics of information and services on the web are defined, making it possible for the web to understand and satisfy the requests of people and machines to use the web content. For realizing the Semantic Web, various methods and technologies are required. One of the most important things is ontology building. An ontology is an explicit specification of conceptualization and shared vocabulary to model a domain. In other words, an ontology is a formal and exact representation of information by concepts and relations between the concepts.

ISO/IEC 11179 - Metadata registries (MDR) addresses the semantics of data, the representation of data, and the registration of the descriptions of that data. MDR provides a good introduction to metadata concepts, including a lot of insight into certain aspects of the granularity of metadata. MDR contributes knowledge integrity in a large scale. In brief, MDR supports semantic interoperability of data, because it provides a set of shared vocabulary for an application domain.

MDR provides shared and common vocabulary (metadata, semantics, or concepts) sets and an ontology is a set of semantics for a domain. It means we can use metadata for generating ontologies. It allows ontology consisting of common concepts to be built and facilitates use of MDR.

The goal of this part of ISO/IEC 20943 is to provide a framework for generating ontologies based on ISO/IEC 11179 MDR. The objectives of this part of ISO/IEC 20943 are to promote the followings:

a) the generation of ontologies consisting of well-defined concepts (i.e., well-known concepts or generalized common concepts, which are accepted by general users as well as domain experts);

b) support of easy and clear understanding of concepts across corresponding same or similar application domains;

c) formalized ontology generation;

d) support of easy definition (building or generation) of ontology;

e) the enhancement of interoperability between ontologies;

f) the facilitation of use of MDR.
Information technology — Procedures for achieving metadata registry content consistency —

Part 6: Framework for generating ontologies

1 Scope

This part of ISO/IEC 20943 covers the framework for generating ontologies based on ISO/IEC 11179 MDR, and provides the procedure and mapping model for generating ontologies.

This part of ISO/IEC 20943 describes the method to generate ontologies for an application domain using concepts in MDR. Most ontologies are composed of classes (concepts), properties, relations between classes, and instances (objects or individuals). This part considers the generation of generic ontology consisting of concepts, properties, and relations.

ISO/IEC 11179-3 has several regions such as Basic region, Identification, Designation and Definition region, Registration region, Concepts region, Data description region, and so on. However, this part of ISO/IEC 20943 does not involve all regions and their components required for generating ontologies. Therefore, this part employs a part of the regions.

This part of ISO/IEC 20943 does not include the specification for definition of ontology in a specific ontology description language, such as RDF, RDF-S, OWL, Topic Maps, KIF, and so on.

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 11179-3:2010, Information technology — Metadata registries (MDR) — Part 3: Registry metamodel and basic attributes

3 Terms and definitions

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

3.1 Terms defined in ISO/IEC 11179-1

3.1.1 conceptual domain
concept that expresses its description or valid instance meanings.
3.1.2 data element concept
caption that can be represented in the form of a data element, described independently of any particular representation.

3.1.3 definition
representation of a concept by a descriptive statement which serves to differentiate it from related concepts.

3.1.4 designation
representation of a concept by a sign which denotes it.

3.1.5 metadata
data that defines and describes other data.

3.1.6 metadata registry
MDR
information system for registering metadata.

3.1.7 object class
set of ideas, abstractions, or things in the real world that are identified with explicit boundaries and meaning and whose properties and behavior follow the same rules.

3.1.8 property
characteristic common to all members of an object class.

3.2 Terms defined in ISO/IEC 11179-3

3.2.1 concept
Unit of knowledge created by a unique combination of characteristics.

3.2.2 concept system
set of concepts structured according to the relations among them.
3.2.3 link
cmember of a relation.

3.2.4 relation
sense in which concepts may be connected via constituent roles.

3.2.5 relation role
role that a concept plays in a relation.

3.3 Terms defined in ISO/IEC 19103

3.3.1 class
description of a set of objects that share the same attributes, operations, methods, relationships and semantics.

3.4 Terms defined in ISO/IEC 19763-3

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

3.5 Definitions of this part of 20943

3.5.1 mapping model
a model for mapping between concepts of 11179-3 and concepts (classes) of generic ontology

4 Overview

This part of ISO/IEC 20943 prescribes a framework based on ISO/IEC 11179-3. This part of ISO/IEC 20943 includes the procedure and mapping model for generating ontologies, as described below:
The procedure involves processes for generating the generic ontologies using the concepts in a metadata registry. The procedure is composed of three main processes (See Clause 4.2).

The mapping model defines mapping relationships between the concepts of ISO/IEC 11179-3 and the concepts of the generic ontology. This mapping model is used to generate ontologies according to the procedure.

4.1 Framework

Figure 1 shows the framework for generating ontologies. Registries built according to ISO/IEC 11179-3 manage various types of metadata including concepts. ISO/IEC 20943-6 refers to common concepts in the registries for generating the generic ontologies. The common concepts are reused to generate the generic ontologies through the mapping model and the procedure described in this part of ISO/IEC 20943.

4.2 Procedure

Figure 2 is the procedure for generating ontologies, and it mainly has three processes as follows:

— Process-1: Selecting a concept system
— Process-2: Defining classes and properties
Process-2 consists of three sub-processes as follows:

— Process-2.1: Defining classes
— Process-2.2: Defining properties

4.2.1 Selecting a concept system

This process selects a concept system which contains concepts required to generate and specify the domain and scope of the generic ontologies.

4.2.2 Defining classes and properties

This process defines classes and properties of the generic ontology using the mapping model which refers to concepts which are defined in the selected concept system at the first step. The Concepts region and The Data description region are defined as class and property respectively.

4.2.2.1 Defining classes

This sub-process defines classes of the generic ontology. With the mapping model, the concepts of 11179-3 which are included in the Concepts region or the Data description region are defined as class of the generic ontology.

4.2.2.2 Defining properties

This sub-process defines properties of the class which is defined in the previous process-2.1. The concepts of the Data description region are defined as properties of the generic ontology. After this sub-process, the process could be moved in process-2.1 in order to define classes of the generic ontology.

4.2.3 Defining relations

This process defines relations between classes which are defined in the previous step, process-2. Through the mapping model, the concepts are defined in the Concepts region or the Data description region could be created as relation of the generic ontology.

4.3 Mapping model

In order to generate the generic ontologies with common concepts in a registry, a mapping model should be defined. The mapping model has a role of mapping between the concepts of ISO/IEC 11179-3 and the concepts of the generic ontology. The mapping model is used as a set of constraints for generating the generic ontologies. In other words, the mapping model determines valid candidates from a registry. The mapping model is based on concepts of ISO/IEC 11179-3 in the Concepts region (4.3.1) and the Data description region (4.3.2).
4.3.1 Mapping between the Concepts region and the generic ontology

Figure 3 shows a mapping model between components of the Concepts region and the generic ontology.

In the Concepts region, there are five concepts used for mapping model. Concept, link, link end, relation, and relation role defined in the Concepts region of ISO/IEC 11179-3 are mapped to class and relation of the generic ontology.

— Concept: Concept defined in ISO/IEC 11179-3 is mapped to class of the generic ontology;
— Link: Link defined in ISO/IEC 11179-3 searches for link end associated with concept by relation;
— Link end: Link end defined in ISO/IEC 11179-3 links between relation role and concept and can search for class associated with relation by link end;
— Relation: Relation defined in ISO/IEC 11179-3 is mapped to relation of the generic ontology;
— Relation role: Relation role defined in ISO/IEC 11179-3 is mapped to domain and range of the generic ontology. Relation defined in ISO/IEC 11179-3 drives directions of relation of the generic ontology when it is mapped.

4.3.2 Mapping between the Data description region and the generic ontology

Figure 3 shows a mapping model between the Data description region and the generic ontology. Four concepts in the Data description region are associated to mapping model for generating the generic ontologies. Conceptual domain, data element concept, object class, and property in the concepts of the Data description region are respectively mapped class and property of the generic ontology.

— Mapping conceptual domain: Conceptual domain defined in ISO/IEC 11179-3 is mapped to class of the generic ontology;
— Mapping data element concept: Data element concept defined in ISO/IEC 11179-3 is mapped to class, relation, and property of the generic ontology. Object class and property associated with data element concept is mapped to class and property of the generic ontology;
— Mapping object class: Object class defined in ISO/IEC 11179-3 is mapped to class of the generic ontology;
Mapping property: Property defined in data description region is mapped to property of the generic ontology:

![Diagram](image)

Figure 4 — Mapping the Data description region to the generic ontology
Annex A
(Informative)

Mapping examples

Figure A.1 — An ontology example and mapping

Figure A.1 shows a graphical example of an ontology and mapping relation using the mapping model. Each component of the ontology is mapped to its corresponding concept of 11179-3 according to the mapping model.

The following tables Table A.1 and Table A.2 show the mapping examples to the Concepts region and the Data description region.

Table A.1 — Mapping example to the Concepts region

<table>
<thead>
<tr>
<th>Concepts of 11179-3 in the Concepts region</th>
<th>Concepts of the generic ontology</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept</td>
<td>Class</td>
<td>Person, Professor, Student</td>
</tr>
<tr>
<td>Relation</td>
<td>Relation</td>
<td>is-a, teach</td>
</tr>
</tbody>
</table>

Table A.2 — Mapping example to the Data description region

<table>
<thead>
<tr>
<th>Concepts of 11179-3 in the Data description region</th>
<th>Concepts of the generic ontology</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object class (same as concept)</td>
<td>Class</td>
<td>Person, Professor, Student</td>
</tr>
<tr>
<td>Property</td>
<td>Property</td>
<td>name, height</td>
</tr>
</tbody>
</table>