

IEEE Standard for Learning Technology— Conceptual Model for Resource Aggregation for Learning, Education, and Training

IEEE Computer Society

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Learning Technology Standards Committee

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IEEE Standard for Learning Technology— Conceptual Model for Resource Aggregation for Learning, Education, and Training

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Abstract: A conceptual model for interpreting externalized representations of digital aggregations of resources for learning, education, and training is defined. The conceptual model is defined as an ontology. Internal compositions and uses of digital resources are not specified nor are processing methods for resource aggregations.

Keywords: aggregation format, conceptual model, content aggregation, digital aggregation, digital resource, IEEE 1484.13.1, resource aggregation, resource aggregation format

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Introduction

This introduction is not part of IEEE Std 1484.13.1-2012, IEEE Standard for Learning Technology—Conceptual Model for Resource Aggregation for Learning, Education, and Training.

This standard defines a conceptual model for interpreting externalized representations of digital aggregations of resources for learning, education, and training. The conceptual model is defined as an ontology. Internal compositions and uses of digital resources are not specified nor are processing methods for resource aggregations.

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Contents

1. Overview	1
1.1 Scope	1
1.2 Purpose	1
2. Normative references.....	2
3. Definitions, acronyms, and abbreviations	2
3.1 Definitions	2
3.2 Acronyms and abbreviations	5
4. Special terms	7
5. Class and property prefix definitions.....	7
6. Conformance	7
6.1 Conforming aggregation instances	8
6.2 Conforming bindings	8
6.3 Conforming mappings	8
6.4 Conforming extensions of the core ontology	8
6.5 Conforming transforming implementations.....	8
7. Conceptual model—classes	9
7.1 ramlet:administrativeDescriptorObject.....	9
7.2 ramlet:admRef	9
7.3 ramlet:aggregationID	10
7.4 ramlet:aggregationSchema	10
7.5 ramlet:aggregationSchemaVersion	11
7.6 ramlet:aggregationType.....	11
7.7 ramlet:alternateID	11
7.8 ramlet:altResourceRef	12
7.9 ramlet:anchor	12
7.10 ramlet:anchorType.....	13
7.11 ramlet:assertion.....	13
7.12 ramlet:beginPoint.....	14
7.13 ramlet:cardinalityLabel.....	14
7.14 ramlet:checksum	14
7.15 ramlet:checksumType.....	15
7.16 ramlet:choice	15
7.17 ramlet:componentTarget.....	16
7.18 ramlet:condition.....	16
7.19 ramlet:coordinates	16
7.20 ramlet:creationDate	17
7.21 ramlet:defaultSelection	17
7.22 ramlet:descriptiveDescriptorObject	18
7.23 ramlet:descriptiveRef.....	18
7.24 ramlet:descriptorObject	18
7.25 ramlet:descriptorTypeIndicator	20
7.26 ramlet:digitalResource	20
7.27 ramlet:digitalResourceFragment.....	20
7.28 ramlet:dynamicStructure.....	21
7.29 ramlet:dynamicStructureID	21

7.30 ramlet:dynamicStructureType	22
7.31 ramlet:elementID	22
7.32 ramlet:encodingType	23
7.33 ramlet:endPoint	23
7.34 ramlet:except	24
7.35 ramlet:extent	24
7.36 ramlet:false	24
7.37 ramlet:fileDescriptor	25
7.38 ramlet:fileSize	25
7.39 ramlet:functionalResourceGroup	26
7.40 ramlet:generatingTool	26
7.41 ramlet:generatingToolVersion	26
7.42 ramlet:groupingID	27
7.43 ramlet:hasOrder	27
7.44 ramlet:hasRank	28
7.45 ramlet:humanLanguage	28
7.46 ramlet:icon	29
7.47 ramlet:identifierType	29
7.48 ramlet:intendedUse	29
7.49 ramlet:interfaceDefLink	30
7.50 ramlet:intraAggregationLink	30
7.51 ramlet:inventory	31
7.52 ramlet:localRef	31
7.53 ramlet:locator	32
7.54 ramlet:locatorDescriptor	32
7.55 ramlet:maxSelections	33
7.56 ramlet:mimeType	33
7.57 ramlet:minSelections	34
7.58 ramlet:modificationDate	34
7.59 ramlet:nodeID	34
7.60 ramlet:nodeVisibility	35
7.61 ramlet:note	35
7.62 ramlet:parallel	36
7.63 ramlet:party	36
7.64 ramlet:partyEmail	37
7.65 ramlet:partyName	37
7.66 ramlet:partyRole	37
7.67 ramlet:partyType	38
7.68 ramlet:partyURI	38
7.69 ramlet:provenance	39
7.70 ramlet:remoteDescriptorObject	39
7.71 ramlet:remoteNode	39
7.72 ramlet:remoteResource	40
7.73 ramlet:remoteTopNode	40
7.74 ramlet:require	41
7.75 ramlet:resourceAggregation	41
7.76 ramlet:resourceGroup	41
7.77 ramlet:resourceIntraAggregationLink	42
7.78 ramlet:resourceProcessing	42
7.79 ramlet:resourceProcessingAlgorithm	43
7.80 ramlet:resourceProcessingBehavior	43
7.81 ramlet:resourceProcessingKey	44
7.82 ramlet:resourceProcessingSet	44
7.83 ramlet:resourceProcessingType	45
7.84 ramlet:resourceType	45
7.85 ramlet:resourceWrapper	45

7.86 ramlet:resourceWrapperSet	46
7.87 ramlet:rights	46
7.88 ramlet:selection	47
7.89 ramlet:shapeIndicator	47
7.90 ramlet:source	47
7.91 ramlet:staticStructure	48
7.92 ramlet:staticStructureSet	48
7.93 ramlet:staticStructureType	49
7.94 ramlet:status	49
7.95 ramlet:stream	50
7.96 ramlet:streamType	50
7.97 ramlet:structRef	50
7.98 ramlet:structureNode	51
7.99 ramlet:structureNodeType	51
7.100 ramlet:technicalDescriptorObject	52
7.101 ramlet:textType	52
7.102 ramlet:title	53
7.103 ramlet:topNode	53
7.104 ramlet:transformOrdering	55
7.105 ramlet:true	55
7.106 ramlet:virtualResourceGroup	56
7.107 ramlet:wholeAggregationDescriptorObject	56
8. Conceptual model—object properties	57
8.1 ramlet:describes	57
8.2 dcterms:hasPart	57
8.3 ramlet:includes	58
8.4 ramlet:isDescribedBy	58
8.5 ramlet:isIncludedBy	58
8.6 dcterms:isPartOf	58
8.7 ramlet:isReferencedBy	59
8.8 ramlet:references	59
9. Conceptual model—data types	59
9.1 xsd:anyURI	60
9.2 xsd:base64Binary	60
9.3 xsd:positiveInteger	60
9.4 xsd:string	60
9.5 xsd:token	60
Annex A (informative) Bibliography	61
Annex B (informative) Conceptual overview	64
Annex C (informative) Ontologies—a brief primer	69
Annex D (informative) Use cases	71
Annex E (informative) Mapping of the XML Linking Language mapping ontology to the conceptual model for resource aggregation	82
Annex F (informative) Graphical representations of RAMLET classes	88

Annex G (informative) Graphical representations of RAMLET properties	130
Annex H (normative) Internet availability and use of the Turtle representations of the conceptual model and XLink mapping	133
Annex I (informative) Internet availability and use of the RDF/XML representations of the conceptual model and XLink mapping	134

IEEE Standard for Learning Technology— Conceptual Model for Resource Aggregation for Learning, Education, and Training

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1. Overview

1.1 Scope

This standard defines a conceptual model for interpreting externalized representations of digital aggregations of resources for learning, education, and training. The conceptual model defines a set of concepts and the relationships among them and is expressed as a formal ontology. Internal compositions and uses of digital resources are not specified nor are processing methods for resource aggregations.

1.2 Purpose

Currently, resource aggregations used in learning, education, and training are defined in a variety of standards and specifications. The conceptual model defined in this standard facilitates interoperability by providing an ontology that can be used to represent a variety of aggregation formats. Interoperability may be achieved by the creation of crosswalks among the various aggregation standards and specifications. In addition, this standard may serve as a common reference for the development and evolution of standards and specifications for resource aggregations and may assist the development of profiles that maximize interoperability between the various aggregation formats.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

W3C[®] Recommendation (28 October 2004), XML Schema Part 2: Datatypes, Second Edition.^{1, 2}

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.³

aggregation definition document: A document that lists and structures the digital resources of an aggregation. *See also:* **digital resource; resource aggregation.**

NOTE—*Examples:* the manifest document in IMS Content Packaging (IMS CP) (IMS Specification [B9]); the mets documents in the Metadata Encoding and Transmission Standard (METS) ([B19], [B20]); the Digital Item Declaration Language (DIDL) document in MPEG-21 Digital Item Declaration (DID) (ISO/IEC 21000-2:2005 [B15]).^{4, 5}

aggregation format: A documented method of aggregating digital resources into a complex object that can be exchanged among systems. An aggregation format may be defined by a formal specification or standard, but may also be informal. The defining characteristic is that an aggregation format specifies how to combine digital resources into a structured whole, without prescribing the kinds of digital resources, their internal structures, or their intended uses. *See also:* **digital resource.**

aggregation instance: An instantiation of an aggregation definition document that includes all data necessary to construct a complex object including any references to external data. Multiple aggregation instances, each of which conforms to a different aggregation format, may exist for the same complex object. *See also:* **aggregation definition document; aggregation format.**

binding: The process that binds a model to a data structure. For example, it can refer to the binding of a conceptual model to the Web Ontology Language (OWL) ontology language.

NOTE—See W3C Recommendation [B29].

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⁴ The numbers in brackets correspond to those of the bibliography in Annex A.

⁵ Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

class: A category of items that share one or more common characteristics. Characteristics can be described informally in a scope note or formally as properties explicitly formulated in logical terms. A class cannot be defined by enumerating its instances because it is generally impossible to know all instances of a class in the world, and the future can bring new instances into being at any time. *See also:* **class instance; open world; scope note.**

class extension: The set of all real-life instances belonging to a class that fulfill the criteria of the class's intention. An extension is an open set in the sense that it is generally impossible to know all instances of a class. In an open world, new instances of a class may be created at any time. *See also:* **class; intention; instance; open world.**

class instance: An instantiation of a class. A class instance has properties that meet the criteria of the intention of the class. The number of instances of a given class declared in an information system is usually less than the total number of instances in the real world. For example, although an individual is an instance of “person,” the individual may not be mentioned in all information systems describing “persons.” *See also:* **class; intention; property.**

component: Any data attribute or data element as described by the data model of an aggregation format. *See also:* **aggregation format; data attribute; data element.**

data attribute: A characteristic of a unit of data, often expressed in Extensible Markup Language (XML).

data element: A uniquely named and defined component of the data model of an aggregation format into which data items (actual values) can be placed. *See also:* **aggregation format; component.**

digital resource: Any resource that can be expressed in an electronic format, such as binary formats, Extensible Markup Language (XML), plain text, various encodings (e.g., base64), media-specific formats, and compressed archives (e.g., zip files).

NOTE—Media-specific formats include Joint Photographic Experts Group [JPEG] (ISO/IEC 10918-1 [B13]) and MPEG-1 Audio Layer 3 [MP3] (ISO/IEC 13818-3 [B14]).

domain: A constraint on a property that limits the class instances to which the property can be applied. Instances of a property are applicable to instances of its domain. For example, if property A has only the classes X and Y as a domain, then only instances of classes X and Y can have property A. *See also:* **class; class instance; property; property instance; range.**

identifier: Associates a name with a thing. Context defines how the name is interpreted. Within a given context, a name is unique.

inheritance: The ability of classes to derive characteristics from other classes and properties to derive characteristics from other properties. If characteristics are removed from a class or property, they are also removed from its subclasses or subproperties. *See also:* **class; multiple inheritance; property; subclass; subproperty.**

intention: The intended meaning of a class or property. The intention consists of the common characteristics shared by all instances of the class or property. The intention need not be explicitly formulated as properties in the case of a class or as the domain and range in the case of a property. Instead, the intention can be described in a scope note that refers to a conceptualization shared by domain experts. *See also:* **class; class instance; domain; property; property instance; range; scope note.**

locator: An identifier that can be used to retrieve a digital resource or component. The digital resource or component may be either internal or external to the aggregation definition document. *See also:* **aggregation definition document; component; digital resource; identifier.**

mapping: An ontology of an aggregation format that relates the aggregation format's classes and properties to the classes and properties of another ontology. *See also:* **aggregation format**.

multiple inheritance: The inheritance of characteristics by a class from more than one immediate superclass or by a property from more than one immediate superproperty. If multiple inheritance is used, the resulting class or property hierarchy is a directed graph, not a tree structure. If multiple inheritance in a class or property hierarchy is represented as an indented list, then some classes or properties will inevitably be repeated at different positions in the indented list. For example, "person" could be a member of both the classes "critic" and "author," and, therefore, would be repeated at different positions in the indented list. This feature distinguishes an ontology from a simple tree structure. *See also:* **class; inheritance; property; superclass; superproperty**.

open world: An assumption that an ontology and its instances are incomplete with regard to the world they attempt to describe. As a consequence, the open-world assumption states that everything that is not known is undefined. In contrast, a closed-world assumption implies that everything that is not known is false.

property: A characteristic that defines a relationship of a specific kind between two classes or sets of classes. A property has exactly one domain and one range. Which classes are selected as the domain and which as the range is arbitrary. In other words, a property can be interpreted in both directions with two distinct but related interpretations. Property names are designed to be semantically meaningful and grammatically correct when read from domain to range. Inverse property names are designed to be semantically meaningful and grammatically correct when read from range to domain. Properties can also be specialized in the same manner as classes, resulting in parent/child relationships between superproperties and their subproperties. Like a class, a property is characterized by an intention, which is conveyed by a scope note. *See also:* **class; domain; intention; range; scope note; subproperty; superproperty**.

property instance: An instantiation of a property that defines the domain and range of a relationship between two classes or sets of classes. For example, class X may be "containedBy" another class Y. In this example, "containedBy" is the instantiation of property. The inverse property in this example would be "contains," i.e., class Y "contains" class X. *See also:* **class; domain; property; range**.

range: The set of instances of a given class to which a property can be applied. For example, the range of property A might consist of those instances of class X and class Y that exhibit property A. A property can link only to instances of the classes that serve as its range. *See also:* **class; class instance; domain; property**.

representation: A method or syntax for serializing data. For example, it can refer to the different serializations of a Web Ontology Language (OWL) ontology according to the Terse RDF Triple Language (Turtle) or Resource Description Framework/Extensible Markup Language (RDF/XML) syntaxes.

NOTE—For OWL, see W3C Recommendation [B29]; for Turtle, see W3C Team Submission [B35].

resource aggregation: (A) Digital resources of diverse types that are gathered together to form a new complex object. Information is contained in the resource aggregation for purposes of specifying the categories of and the relationships among the aggregated resources. A resource aggregation may be contained in an exchange file or not, and may be self-contained or reference resources held in other locations. A resource aggregation may be disaggregated into its component digital resources. Resource aggregations are stored and processed using system formats (internal representations) and are usually transmitted between systems using aggregation formats. *See also:* **aggregation format; digital resource**. (B) The process of aggregating digital resources so that the result can be used in one or more applications, such as transmission, storage, and delivery to users. *See also:* **digital resource**.

scope note: A textual description of the intention of a class or property. Scope notes are not formal constructs but are provided to help explain the intended meaning and application of classes and properties. *See also:* **class; intention; property**.

strict inheritance: The inheritance of characteristics by classes or properties that allows no exceptions. *See also:* **class; inheritance; property.**

subclass: A specialization of a class by inheritance from one or more superclasses. A subclass inherits all the properties of its superclasses (i.e., *strict inheritance*) in addition to having zero or more additional properties of its own. If a subclass inherits properties from more than one superclass, it is said to have multiple inheritance. *See also:* **class; inheritance; multiple inheritance; property; subclass; superclass.**

subproperty: A specialization of a property by inheritance from one or more superproperties. All instances of a subproperty are also instances of its immediate superproperty. The intention of a subproperty extends the intention of its immediate superproperty, i.e., its characteristics are more restrictive than that of its superproperty. *See also:* **inheritance; intention; property instance; superproperty.**

superclass: A generalization of one or more other classes, i.e., the *subclasses*. A superclass subsumes all instances of its subclasses and may have additional instances that do not belong to any of its subclasses. The intention of the superclass is less restrictive than the intentions of any of its subclasses. A superclass/subclass relationship may also be referred to as a *parent/child relationship*. *See also:* **class; class instance; intention; subclass.**

superproperty: A generalization of one or more other properties, i.e., the subproperties. A superproperty subsumes all instances of its subproperties and may have additional instances that do not belong to any of its subproperties. A superproperty/subproperty relationship may also be referred to as a *parent/child relationship*. The intention of the superproperty is less restrictive than the intentions of any of its subproperties. *See also:* **intention; property; subproperty.**

3.2 Acronyms and abbreviations

ALOCOM	Abstract Learning Object Content Model
Atom	Atom Syndication Format
CAD	computer-aided design
CODEC	compressor-decompressor
DC	Dublin Core ^{™ 6}
DID	Digital Item Declaration
DIDL	Digital Item Declaration Language
DOI	Digital Object Identifier
EAD	Encoded Archival Description
HTML	Hypertext Markup Language
IMS CP	IMS Content Packaging
ISBN	International Standard Book Number
JPEG	Joint Photographic Experts Group
LMS	learning management system

⁶ Dublin Core is a trademark of the Dublin Core Metadata Initiative Limited (USPTO 2519654).

LOM	Learning Object Metadata
MARC	Machine-Readable Cataloging
MD5	Message-Digest algorithm 5
METS	Metadata Encoding and Transmission Standard
MIME	Multipurpose Internet Mail Extension
MP3	MPEG-1 Audio Layer 3
MPEG	Moving Pictures Experts Group
OAI-ORE	Open Archives Initiative Object Reuse and Exchange
OASIS	Organization for the Advancement of Structured Information Standards
ODRL	Open Digital Rights Language
OWL	Web Ontology Language
PDA	personal digital assistant
RAMLET	Resource Aggregation Models for Learning, Education, and Training
RDF	Resource Description Framework
RDFS	RDF Schema
RSS	Really Simple Syndication
RTS	run-time system
SCO	Shareable Content Object
SKOS	Simple Knowledge Organization System
SPARQL	SPARQL Protocol and RDF Query Language
Turtle	Terse RDF Triple Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
W3C	World Wide Web Consortium
WAVE	Waveform Audio File Format
XLink	XML Linking Language
XML	Extensible Markup Language
XPath	XML Path Language
XSLT	Extensible Stylesheet Language Transformations

4. Special terms

In this standard, the following special term and definition applies.

core ontology: A shorthand way of referencing the conceptual model described in this standard. The core ontology does not include any recommended practice mappings.

5. Class and property prefix definitions

The class and property names in this standard included prefixes that reference the documents in which the classes and properties are fully described. The prefixes used and the documents they reference are as follows:

- atom: IEEE P1484.13.5TM, Draft Recommended Practice for Learning Technology—IETF RFC 4287—Atom Syndication Format—Mapping to the Conceptual Model for Resource Aggregation.⁷
- cp: IEEE P1484.13.4TM, Draft Recommended Practice for Learning Technology—IMS Content Packaging Information Model (CP) Version 1.2—Mapping to the Conceptual Model for Resource Aggregation.
- dcterms: Dublin Core Metadata Initiative Recommendation [B3] (10 November 2010), DCMI Metadata Terms, <http://www.dublincore.org/documents/2010/10/11/dcmi-terms/>.
- mets: IEEE P1484.13.2TM, Draft Recommended Practice for Learning Technology—Metadata Encoding and Transmission Standard (METS) Mapping to the Conceptual Model for Resource Aggregation.
- mpeg: IEEE P1484.13.3TM, Draft Recommended Practice for Learning Technology—ISO 21000-2:2005 Information Technology—Multimedia Framework (MPEG-21)—Part 2: Digital Item Declaration Mapping to the Conceptual Model for Resource Aggregation.
- oai-ore: IEEE P1484.13.6TM, Draft Recommended Practice for Learning Technology—Open Archives Initiative Object Reuse and Exchange Abstract Model (OAI-ORE)—Mapping to the Conceptual Model for Resource Aggregation.
- owl: W3C OWL 2 Namespace Document, <http://www.w3.org/2002/07/owl#>.
- ramlet: This standard.
- xlink: This standard (see Annex E).
- xmlns: W3C Recommendation, Namespaces in XML 1.0 (Third Edition) [B28], <http://www.w3.org/TR/2009/REC-xml-names-20091208>.
- xsd: W3C Recommendation, XML Schema Part 2: Datatypes, Second Edition, <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028>.⁸

6. Conformance

Conformance to this standard is discussed in 6.1 through 6.5.

In this standard, “shall” is to be interpreted as a requirement; “shall not” is to be interpreted as a prohibition.

⁷ IEEE P1484.13.2, IEEE P1484.13.3, IEEE P1484.13.4, IEEE P1484.13.5, and IEEE P1484.13.6 are in development. For more information, contact the IEEE.

⁸ Information on references can be found in Clause 2.

6.1 Conforming aggregation instances

A conforming aggregation instance shall be an instance of an aggregation format that has been modeled or described in terms of the core ontology (via a mapping or otherwise) following the intentions of the core ontology as expressed in Clause 7, Clause 8, and Clause 9 of this standard.

6.2 Conforming bindings

Conforming bindings of the core ontology:

- Shall conform to the requirements of Clause 7, Clause 8, and Clause 9 of this standard.
- If the binding technology language supports Uniform Resource Identifiers (URIs), then it shall use the same URIs as those in the Terse RDF Triple Language (Turtle) representation referenced in Annex H of this standard.
- If the binding technology language supports URIs and the binding contains extensions to the core ontology (see 6.4), then identifiers for the extensions shall be defined in another namespace.

6.3 Conforming mappings

Conforming mappings for new aggregation formats may be defined. A conforming mapping shall be an ontology of an aggregation format expressed in terms of the core ontology defined in Clause 7, Clause 8, and Clause 9 of this standard. Conformance requirements for mappings include the following:

- When a concept is already expressed as a class or property in the core ontology, the mapping shall use the identifiers for that class or property as defined in the core ontology.
- When a concept is not already expressed as a class or property in the core ontology, the mapping may extend the core ontology by adding a new class or property and by defining a new identifier. The new identifier shall not be used to identify a concept that already exists in the core ontology.

6.4 Conforming extensions of the core ontology

When a concept relating to interpreting externalized representations of digital aggregations is not already expressed as a class or property in the core ontology, a mapping may extend the core ontology. The core ontology may be extended by adding a new class or property and by defining a new identifier in a new ontology. The new identifier shall not be used to identify a concept that already exists in the core ontology. Bindings for conforming extensions shall conform to the requirements in 6.2.

NOTE—Concepts relating to interpreting externalized representations of digital aggregations should be defined as conforming extensions to the core ontology. Other concepts may be represented by other vocabularies or ontologies and combined with the core ontology using standard Semantic Web practices.

6.5 Conforming transforming implementations

A conforming transforming implementation shall implement a transformation from an aggregation format to the core ontology and its identifiers or from the core ontology and its identifiers to an aggregation format by using a model following the intention of the core ontology as defined in classes in Clause 7, Clause 8, and Clause 9 of this standard.

NOTE—In an implementation that transforms between two aggregation formats, the core ontology need not be physically instantiated for the implementation to conform.

7. Conceptual model—classes

This clause provides declarations of all the classes in the core ontology. The declarations use the following format:

- Class name: The name of the class.
- Subclass of: The parent of the class. The class may inherit properties from its parent.
- Superclass of: The children of the class that are also in the core ontology.
- Scope note: A textual description of the class.
- Data type: The data type of the class as defined in Clause 9.
- Properties: The properties of the class as described in Clause 8. Inherited properties are not included in the entry.
- Asserted conditions: Any conditions that are asserted for the class as a result of restrictions on its properties.
- Examples: Examples of subclasses from aggregation formats that map to the class.

7.1 ramlet:administrativeDescriptorObject

Class name:	ramlet:administrativeDescriptorObject
Subclass of:	ramlet:descriptorObject
Superclass of:	None
Scope note:	Contains information about the management of digital resources in an aggregation instance.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	cp:version mets:amdSec

7.2 ramlet:admRef

Class name:	ramlet:admRef
Subclass of:	ramlet:locator
Superclass of:	None

Scope note:	A locator (see 7.53) that associates administrative metadata with a digital resource or groups of digital resources that share the administrative metadata.
Properties:	None
Data type:	xsd:anyURI
Asserted conditions:	None
Examples:	mets:admID

7.3 ramlet:aggregationID

Class name:	ramlet:aggregationID
Subclass of:	owl:class
Superclass of:	None
Scope note:	An identifier for an aggregation instance as a whole. Generally, ramlet:aggregationID is used by external systems.
Properties:	dcterms:isPartOf someValueFrom ramlet:topNode
Data type:	None
Asserted conditions:	Being a member of this class implies that an individual is a member of owl:class. Being a member of this class implies that an individual has some value of the property dcterms:isPartOf that is a member of ramlet:topNode.
Examples:	atom:ID mets:objID mpeg:didlDocumentID

7.4 ramlet:aggregationSchema

Class name:	ramlet:aggregationSchema
Subclass of:	ramlet:descriptorObject
Superclass of:	None
Scope note:	An identifying string for a formal schema binding of an aggregation format.
Properties:	None
Data type:	None
Asserted conditions:	None

Examples: cp:schema
 mets:profile
 mpeg:schema

7.5 ramlet:aggregationSchemaVersion

Class name: ramlet:aggregationSchemaVersion
Subclass of: ramlet:descriptorObject
Superclass of: None
Scope note: An identifier for a formal schema binding of an aggregation format.
Properties: None
Data type: None
Asserted conditions: None
Examples: cp:schemaVersion

7.6 ramlet:aggregationType

Class name: ramlet:aggregationType
Subclass of: ramlet:descriptorObject
Superclass of: None
Scope note: The category of an aggregation instance, e.g., IMS Content Packaging (IMS CP) (IMS Specification [B9]) or Metadata Encoding and Transmission Standard (METS) ([B19], [B20]).
Properties: None
Data type: None
Asserted conditions: None
Examples: mets:metsType

7.7 ramlet:alternateID

Class name: ramlet:alternateID
Subclass of: ramlet:descriptorObject
Superclass of: None

Scope note:	An identifying string by which an associated component is known in another system.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mets:altRecordID mets:ownerID

7.8 ramlet:altResourceRef

Class name:	ramlet:altResourceRef
Subclass of:	ramlet:descriptiveRef
Superclass of:	None
Scope note:	Locates a ramlet:resourceGroup that has different media accessibility properties from the ramlet:resourceGroup (see 7.76) that includes the ramlet:altResourceRef.
Properties:	None
Data type:	xsd:anyURI
Asserted conditions:	None
Examples:	cp:variant

7.9 ramlet:anchor

Class name:	ramlet:anchor
Subclass of:	owl:class
Superclass of:	ramlet:anchorType ramlet:beginPoint ramlet:componentTarget ramlet:coordinates ramlet:endpoint ramlet:extent ramlet:shapeIndicator ramlet:stream ramlet:streamType
Scope note:	Contains components that identify and describe a portion of or location within a digital resource, e.g., a specific point in time in an audio file or a shape within a larger image.

Properties:	dterms:isPartOf someValueFrom ramlet:topNode
Data type:	None
Asserted conditions:	Being a member of this class implies that an individual is a member of owl:class. Being a member of this class implies that an individual has some value of the property dterms:isPartOf that is a member of ramlet:topNode.
Examples:	mets:area mpeg:anchor mpeg:fragment

7.10 ramlet:anchorType

Class name:	ramlet:anchorType
Subclass of:	ramlet:anchor
Superclass of:	None
Scope note:	The unit of measurement used by an anchor (see 7.9), e.g., time or byte.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mets:beType mets:extType

7.11 ramlet:assertion

Class name:	ramlet:assertion
Subclass of:	ramlet:dynamicStructure
Superclass of:	None
Scope note:	Defines a full or partially configured state of a choice (see 7.16) by asserting true (see 7.105) or false (see 7.36) values for some number of predicate tests associated with the selections for that choice. If no assertion is made, the choice is undecided. For example, an assertion could be used to “save” a configuration within an aggregation definition document. The assertion would target the format choice and might assert true for the predicate test of the MPEG–1 Audio Layer 3 (MP3) (ISO/IEC 13818-3 [B14]) selection so that the MP3 component is selected by default.
Properties:	None

Data type: None
Asserted conditions: None
Examples: mpeg:assertion

7.12 ramlet:beginPoint

Class name: ramlet:beginPoint
Subclass of: ramlet:anchor
Superclass of: None
Scope note: Indicates at what point within a digital resource an anchor (see 7.9) starts.
Properties: None
Data type: None
Asserted conditions: None
Examples: mets:begin

7.13 ramlet:cardinalityLabel

Class name: ramlet:cardinalityLabel
Subclass of: ramlet:title
Superclass of: None
Scope note: Elements that define a label for an order sequence, e.g., “I”, “a)” or “1.”
Properties: None
Data type: xsd:string
Asserted conditions: None
Examples: mets:orderLabel

7.14 ramlet:checksum

Class name: ramlet:checksum
Subclass of: ramlet:descriptorObject
Superclass of: None

Scope note:	A value used to ensure the integrity of a digital resource after the resource has been stored or transmitted.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mets:checksum

7.15 ramlet:checksumType

Class name:	ramlet:checksumType
Subclass of:	ramlet:descriptorObject
Superclass of:	None
Scope note:	The algorithm used to calculate the checksum of a digital resource, e.g., CRC-32—IEEE-802.3 (Koopman [B16]) or Message-Digest algorithm 5 (MD5) IETF RFC 1321 [B6]).
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mets:checksumType

7.16 ramlet:choice

Class name:	ramlet:choice
Subclass of:	ramlet:dynamicStructure
Superclass of:	None
Scope note:	Contains components of a ramlet:dynamicStructure (see 7.28) that identify members of a set of selection(s) (see 7.88) that enable a processing application to choose among options for processing a digital resource.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mpeg:choice

7.17 ramlet:componentTarget

Class name:	ramlet:componentTarget
Subclass of:	ramlet:anchor
Superclass of:	None
Scope note:	An anchor (see 7.9) that identifies or describes a portion of a digital resource dynamically at runtime, e.g., via an XML Path Language (XPath) (W3C [B37]) expression that is encapsulated in a Uniform Resource Locator (URL).
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	cp:xPointer mets:xptr

7.18 ramlet:condition

Class name:	ramlet:condition
Subclass of:	ramlet:dynamicStructure
Superclass of:	None
Scope note:	A logical condition. In a particular aggregation instance, a condition denotes that its parent component is conditional on a set of predicate tests [see the example of choice (7.16)]. The require component (see 7.74) lists the set of predicate tests that must become true and the ramlet:except component (see 7.34) lists the set of predicate tests that must become false in order for the condition to be satisfied. Each predicate test is identified by the value of the ramlet:dynamicStructureID (see 7.29) included in a selection (see 7.88).
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mpeg:condition

7.19 ramlet:coordinates

Class name:	ramlet:coordinates
Subclass of:	ramlet:anchor

Superclass of:	None
Scope note:	The boundaries of the shape of an anchor (see 7.9). Typically, this class is used with <code>ramlet:shapeIndicator</code> (see 7.89), e.g., to define a region within an image.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	<code>mets:coords</code>

7.20 `ramlet:creationDate`

Class name:	<code>ramlet:creationDate</code>
Subclass of:	<code>ramlet:descriptorObject</code>
Superclass of:	None
Scope note:	A recognized creation date related to a digital resource or an aggregation instance, e.g., the date a digital resource was made available in a system or when an aggregation instance was created.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	<code>atom:published</code> <code>mets:created</code> <code>mets:createDate</code> <code>mets:versDate</code>

7.21 `ramlet:defaultSelection`

Class name:	<code>ramlet:defaultSelection</code>
Subclass of:	<code>ramlet:dynamicStructure</code>
Superclass of:	None
Scope note:	The <code>ramlet:dynamicStructureID(s)</code> (see 7.29) associated with a selection that should be chosen by a processing application automatically in the absence of any actively chosen <code>ramlet:selection(s)</code> (see 7.88).
Properties:	None
Data type:	None

Asserted conditions: None

Examples: cp:default
mpeg:default

7.22 ramlet:descriptiveDescriptorObject

Class name: ramlet:descriptiveDescriptorObject

Subclass of: ramlet:descriptorObject

Superclass of: None

Scope note: Information to support finding, identifying, selecting, and obtaining a digital resource.

Properties: None

Data type: None

Asserted conditions: None

Examples: atom:subtitle
atom:summary
mets:dmdSec

7.23 ramlet:descriptiveRef

Class name: ramlet:descriptiveRef

Subclass of: ramlet:locator

Superclass of: ramlet:altResourceRef

Scope note: A ramlet:locator (see 7.53) that associates descriptive metadata with digital resources or resource groupings.

Properties: None

Data type: xsd:anyURI

Asserted conditions: None

Examples: mets:dmdID
mpeg:target

7.24 ramlet:descriptorObject

Class name: ramlet:descriptorObject

Subclass of:	owl:class
Superclass of:	ramlet:administrativeDescriptorObject ramlet:aggregationSchema ramlet:aggregationType ramlet:alternateID ramlet:checksum ramlet:checksumType ramlet:creationDate ramlet:descriptiveDescriptorObject ramlet:descriptorType ramlet:descriptorTypeIndicator ramlet:encodingType ramlet:fileSize ramlet:generatingTool ramlet:humanLanguage ramlet:identifierType ramlet:intendedUse ramlet:modificationDate ramlet:nodeVisibility ramlet:note ramlet:party ramlet:provenance ramlet:resourceProcessing ramlet:resourceType ramlet:rights ramlet:source ramlet:status ramlet:structureNodeType ramlet:technicalDescriptorObject ramlet:textType ramlet:wholeAggregationDescriptorObject
Scope note:	Information that describes a digital resource for purposes of discovery and identification by a human reader.
Properties:	dcterms:isPartOf someValueFrom ramlet:topNode
Data type:	None
Asserted conditions:	Being a member of this class implies that an individual is a member of owl:class. Being a member of this class implies that an individual has some value of the property dcterms:isPartOf that is a member of ramlet:topNode.
Examples:	atom:category atom:term cp:metadata mets:mdWrap mpeg:annotation mpeg:descriptor mpeg:statement

7.25 ramlet:descriptorTypeIndicator

Class name:	ramlet:descriptorTypeIndicator
Subclass of:	ramlet:descriptorObject
Superclass of:	None
Scope note:	The category for the type of metadata contained in a component, e.g., Machine-Readable Cataloging (MARC) (MARC 21 [B18]), Learning Object Metadata (LOM) (IEEE Std 1484.12.1™-2002 [B5]), or Dublin Core Metadata Initiative [B3].
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	atom:scheme mets:mdType mets:otherMdType

7.26 ramlet:digitalResource

Class name:	ramlet:digitalResource
Subclass of:	owl:class
Superclass of:	ramlet:digitalResourceFragment
Scope note:	Refers to a digital resource contained in an aggregation instance.
Properties:	dcterms:isPartOf someValueFrom ramlet:topNode
Data type:	None
Asserted conditions:	Being a member of this class implies that an individual is a member of owl:class. Being a member of this class implies that an individual has some value of the property dcterms:isPartOf that is a member of ramlet:topNode.
Examples:	oai-ore:aggregatedResource

7.27 ramlet:digitalResourceFragment

Class name:	ramlet:digitalResourceFragment
Subclass of:	ramlet:digitalResource

Superclass of:	None
Scope note:	A part of a digital resource described within an aggregation instance.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	None

7.28 ramlet:dynamicStructure

Class name:	ramlet:dynamicStructure
Subclass of:	owl:class
Superclass of:	ramlet:assertion ramlet:choice ramlet:condition ramlet:defaultSelection ramlet:dynamicStructureID ramlet:dynamicStructureType ramlet:except ramlet:false ramlet:maxSelections ramlet:minSelections ramlet:require ramlet:selection ramlet:true
Scope note:	Contains the relationships among ramlet:structureNode(s) (see 7.98) in an aggregation instance that depend on factors true for only one state. The state of the relationships depends upon the processing at run time, e.g., the state may change after user interactions.
Properties:	dcterms:isPartOf someValueFrom ramlet:topNode
Data type:	None
Asserted conditions:	Being a member of this class implies that an individual is a member of owl:class. Being a member of this class implies that an individual has some value of the property dcterms:isPartOf that is a member of ramlet:topNode.
Examples:	mpeg:container

7.29 ramlet:dynamicStructureID

Class name:	ramlet:dynamicStructureID
-------------	---------------------------

Subclass of:	ramlet:dynamicStructure
Superclass of:	None
Scope note:	Identifies components eligible to be included in a ramlet:dynamicStructure (see 7.28).
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mpeg:choiceID mpeg:selectID

7.30 ramlet:dynamicStructureType

Class name:	ramlet:dynamicStructureType
Subclass of:	ramlet:dynamicStructure
Superclass of:	None
Scope note:	The category of a ramlet:dynamicStructure (see 7.28) within an aggregation instance, e.g., display behavior or authentication approval.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mets:bType

7.31 ramlet:elementID

Class name:	ramlet:elementID
Subclass of:	owl:class
Superclass of:	ramlet:nodeID
Scope note:	A local identifier for a data element in an aggregation instance.
Properties:	dterms:isPartOf someValueFrom ramlet:topNode
Data type:	None

Asserted conditions: Being a member of this class implies that an individual is a member of owl:Class.

Being a member of this class implies that an individual has some value of the property `dcterms:isPartOf` that is a member of `ramlet:topNode`.

Examples: `atom:ID`
`cp:identifier`
`mets:ID`
`mpeg:ID`
`mpeg:identifier`
`mpeg:target`

7.32 ramlet:encodingType

Class name: `ramlet:encodingType`

Subclass of: `ramlet:descriptorObject`

Superclass of: None

Scope note: The encoding method for a digital resource, e.g., an audio track encoded as base64.

Properties: None

Data type: None

Asserted conditions: None

Examples: `mpeg:contentEncoding`
`mpeg:encoding`

7.33 ramlet:endPoint

Class name: `ramlet:endPoint`

Subclass of: `ramlet:anchor`

Superclass of: None

Scope note: Indicates at what point within a digital resource a `ramlet:anchor` (see 7.9) ends.

Properties: None

Data type: None

Asserted conditions: None

Examples: `mets:end`

7.34 ramlet:except

Class name:	ramlet:except
Subclass of:	ramlet:dynamicStructure
Superclass of:	None
Scope note:	The set of predicate tests that are required to become false in order to satisfy a ramlet:condition (see 7.18).
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mpeg:except

7.35 ramlet:extent

Class name:	ramlet:extent
Subclass of:	ramlet:anchor
Superclass of:	None
Scope note:	Measures the sequential or contiguous portion of a digital resource defined by a ramlet:anchor (see 7.9), e.g., the duration of an audio clip or the coordinates of an area within an image.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	atom:length mets:extent

7.36 ramlet:false

Class name:	ramlet:false
Subclass of:	ramlet:dynamicStructure
Superclass of:	None
Scope note:	Asserts an associated ramlet:condition (see 7.18) to be false.

Properties: None
Data type: None
Asserted conditions: None
Examples: mpeg:false

7.37 ramlet:fileDescriptor

Class name: ramlet:fileDescriptor
Subclass of: owl:class
Superclass of: None
Scope note: Contains file descriptors relating to a single digital resource, e.g., locators, file size.
Properties: dterms:isPartOf someValueFrom ramlet:topNode
Data type: None
Asserted conditions: Being a member of this class implies that an individual is a member of owl:class.

Being a member of this class implies that an individual has some value of the property dterms:isPartOf that is a member of ramlet:topNode.
Examples: atom:entry
atom:link
cp:file
mets:file
mpeg:resource

7.38 ramlet:fileSize

Class name: ramlet:fileSize
Subclass of: ramlet:descriptorObject
Superclass of: None
Scope note: The size of a file or bitstream referenced in an aggregation instance. The expression of the unit of measurement is specified by the mapping.
Properties: None
Data type: None
Asserted conditions: None
Examples: mets:size

7.39 ramlet:functionalResourceGroup

Class name:	ramlet:functionalResourceGroup
Subclass of:	ramlet:resourceGroup
Superclass of:	None
Scope note:	Contains a collection of ramlet:fileDescriptor(s) (see 7.37) for a set of functionally related digital resources.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	cp:resource mets:fileGrp mpeg:component

7.40 ramlet:generatingTool

Class name:	ramlet:generatingTool
Subclass of:	ramlet:descriptorObject
Superclass of:	ramlet:generatingToolVersion
Scope note:	The tool used to create an aggregation instance.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	atom:generator

7.41 ramlet:generatingToolVersion

Class name:	ramlet:generatingToolVersion
Subclass of:	ramlet:generatingTool
Superclass of:	None
Scope note:	The version of the tool used to create an aggregation instance.
Properties:	None

Data type: None

Asserted conditions: None

Examples: atom:version

7.42 ramlet:groupingID

Class name: ramlet:groupingID

Subclass of: owl:class

Superclass of: None

Scope note: Associates multiple digital resources into a group by means of a single group identifier.

Properties: dterms:isPartOf someValueFrom ramlet:topNode

Data type: None

Asserted conditions: Being a member of this class implies that an individual is a member of owl:class.

Being a member of this class implies that an individual has some value of the property dterms:isPartOf that is a member of ramlet:topNode.

Examples: mets:groupID

7.43 ramlet:hasOrder

Class name: ramlet:hasOrder

Subclass of: owl:class

Superclass of: ramlet:transformOrdering

Scope note: A preferred order by sequence for digital resources and/or portions of digital resources within an aggregation instance, e.g., for rendering pages in a book in a preferred sequence.

Properties: dterms:isPartOf someValueFrom ramlet:topNode

Data type: None

Asserted conditions: Being a member of this class implies that an individual is a member of owl:class.

Being a member of this class implies that an individual has some value of the property dterms:isPartOf that is a member of ramlet:topNode.

Examples: mets:order
mets:seq

7.44 ramlet:hasRank

Class name:	ramlet:hasRank
Subclass of:	owl:class
Superclass of:	None
Scope note:	A preference by rank for digital resources and/or portions of a digital resource within an aggregation instance. A digital resource or portion thereof may have no rank, the same rank, or a different rank from another. For example, the beginning of an audio clip may be denoted as the starting point for a whole session. A second point placed at 17 minutes 30 seconds past the beginning of the audio clip begins a drum solo section within the audio file that is described separately but still included within the aggregation instance. By assigning a high ramlet:hasRank value to the beginning point of the audio clip and either a lower or no ramlet:hasRank value to the drum solo, a user interface would display the beginning of the session first when displaying the list of byte streams within the file and make the beginning of the session the default display.
Properties:	dcterms:isPartOf someValueFrom ramlet:topNode
Data type:	None
Asserted conditions:	Being a member of this class implies that an individual is a member of owl:class. Being a member of this class implies that an individual has some value of the property dcterms:isPartOf that is a member of ramlet:topNode.
Examples:	mpeg:precedence

7.45 ramlet:humanLanguage

Class name:	ramlet:humanLanguage
Subclass of:	ramlet:descriptorObject
Superclass of:	None
Scope note:	The category for the human language in which a digital resource is rendered, e.g., en-GB or fr-CA.
Properties:	None
Data type:	xsd:token
Asserted conditions:	None
Examples:	atom:hrefLang cp:language

7.46 ramlet:icon

Class name:	ramlet:icon
Subclass of:	owl:class
Superclass of:	None
Scope note:	An image that visually identifies an aggregation instance or a digital resource to a user via an appropriate tool, e.g., a logo.
Properties:	dcterms:isPartOf someValueFrom ramlet:topNode
Data type:	None
Asserted conditions:	Being a member of this class implies that an individual is a member of owl:class. Being a member of this class implies that an individual has some value of the property dcterms:isPartOf that is a member of ramlet:topNode.
Examples:	atom:icon atom:logo

7.47 ramlet:identifierType

Class name:	ramlet:identifierType
Subclass of:	ramlet:descriptorObject
Superclass of:	None
Scope note:	The category for an identifier used within an aggregation instance, e.g., International Standard Book Number (ISBN) (ISO 2108 [B10]) or Digital Object Identifier (DOI) (ISO 26324 [B12]).
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mets:altRecordIDType

7.48 ramlet:intendedUse

Class name:	ramlet:intendedUse
Subclass of:	ramlet:descriptorObject

Superclass of:	None
Scope note:	How a digital resource is expected to be used, e.g., as an archival-quality image, thumbnail, or audio sample.
Properties:	None
Data type:	None
Asserted conditions:	None
Examples:	mets:use

7.49 ramlet:interfaceDefLink

Class name:	ramlet:interfaceDefLink
Subclass of:	ramlet:locator
Superclass of:	None
Scope note:	Contains components that point to a definition of a single behavior or a set of behaviors associated with a digital resource. The definition may be either human or machine readable. Alternatively, ramlet:interfaceDefLink can point directly to the single behavior or set of behaviors, e.g., a piece of executable code. ramlet:interfaceDefLink may be embedded within a resourceProcessingSet (see 7.82).
Properties:	None
Data type:	xsd:anyURI
Asserted conditions:	None
Examples:	mets:interfaceDef mets:mechanism

7.50 ramlet:intraAggregationLink

Class name:	ramlet:intraAggregationLink
Subclass of:	ramlet:locator
Superclass of:	ramlet:resourceIntraAggregationLink
Scope note:	Contains ramlet:resourceIntraAggregationLink(s) (see 7.77).
Properties:	None

Data type: xsd:anyURI

Asserted conditions: None

Examples: mets:structLink

7.51 ramlet:inventory

Class name: ramlet:inventory

Subclass of: owl:class

Superclass of: None

Scope note: Contains the list of all digital resources included in an aggregation instance.

Properties: dterms:isPartOf someValueFrom ramlet:topNode

Data type: None

Asserted conditions: Being a member of this class implies that an individual is a member of owl:class.

Being a member of this class implies that an individual has some value of the property dterms:isPartOf that is a member of ramlet:topNode.

Examples: cp:resources
mets:fileSec

7.52 ramlet:localRef

Class name: ramlet:localRef

Subclass of: ramlet:locator

Superclass of: None

Scope note: A ramlet:locator (see 7.53) for a component within an aggregation definition document.

Properties: None

Data type: xsd:anyURI

Asserted conditions: None

Examples: cp:identifierRef
mets:fileID