Guidelines for using the PREMIS Version 3 OWL Ontology

Acknowledgments

Introduction
  Differences Between v. 2 and v. 3 Ontology
  Preservation Vocabularies Integration
  External vocabularies
  Conventions
    Typographic conventions
    Diagram conventions

Identifier

Relationships Between PREMIS Entities
  Object to Event
  Object to Rights
  Event to Object
  Event to Agent
  Agent to Event
  Rights to Agent
  Agent to Object
  Agent to Rights
  Rights to Object

Object
  Object type (objectCategory)
  Preservation Policy (preservationLevel)
  Significant Properties
  Compound Objects (compositionLevel)
  Fixity
  Size
  Format
  Creating Application
  Inhibitors
  Original Name
  Storage
  Signature
  Environment
  Relationships between Objects
  Objects sequencing (relatedObjectSequence)

Event

Agent

Rights
  Rights Basis
  Rights status
  Rule (rightsGranted)
Acknowledgments

The PREMIS Editorial Committee appointed a working group to revise the previous ontology consisting of the following members:

Charles Blair (University of Chicago)
Lina Bountouri (Publications Office of the European Union)
Bertrand Caron (Bibliothèque nationale de France)
Esmé Cowles (Princeton University)
Angela DiIorio (Sapienza Università di Roma)
Rebecca Guenther (Consultant, Library of Congress)
Evelyn McLellan (Artefactual Systems)
Elizabeth Russey Roke (Emory University)

Introduction

PREMIS is based on a data model that defines the entities that are described (Objects, Events, Agents and Rights), the properties of those entities (semantic units), and relationships between them. This PREMIS OWL ontology provides an RDF encoding reflecting that model. This document is based on the PREMIS Data Dictionary version 3 (http://www.loc.gov/standards/premis/v3/premis-3-0-final.pdf). Readers should refer to it for the definitions of PREMIS terms.

These guidelines aim only to provide an endorsed expression of the PREMIS Data Dictionary version 3.0 and its data model in RDF, in order to facilitate interoperability between repositories or registries publishing or exchanging metadata about digital objects. Implementers are therefore encouraged to use the RDF constructs listed below and supplement them by creating subclasses and subproperties of their own where necessary.

Please also note that, because the RDF expression recommended in this document directly reuses some external vocabularies, this document should be read before using the PREMIS Ontology 3.0.

Implementation details like OWL version, OWL sublanguage, preferred prefix and namespace URI will be determined when the final version of the ontology gets published.

Differences Between v. 2 and v. 3 Ontology

This is a revision of an RDF ontology based on the PREMIS Data Dictionary version 2.2 available at: http://www.loc.gov/premis/rdf/v1. It is a substantial remodeling based on incorporating emerging Linked Data best practices, such as reusing and connecting to classes and properties from other related ontologies. The previous version of the ontology reflected an encoding of the PREMIS Data Dictionary in RDF, which was fairly faithful to the semantic units of the Data Dictionary, enhanced by value vocabularies, available at http://id.loc.gov/preservationdescriptions. This revision asserts relationships between PREMIS classes and properties and other vocabularies, and in some cases reuses external classes and properties. Generalized properties are used throughout the ontology, such as for identifier, note, and version.
The basic principles followed for the PREMIS OWL ontology 3.0 were:

- Make the ontology as simple as possible.
- Reuse existing elements from well-known ontologies where possible and where semantics agree.
- Make relationships between PREMIS elements and those from well-known ontologies (with skos:closeMatch, skos:exactMatch). These can be hierarchical relationships (e.g. class/subclass, property/subproperty) or equivalencies (skos:exactMatch, skos:closeMatch).
- Use URIs to identify things rather than strings. If there is an enumerable set, then create URIs for the items of the set. These are done in http://id.loc.gov/preservationdescriptions
- Follow RDF constructions, rather than XML constructions. Use data dictionary names where appropriate.
- Types / Categories for an object are classes, using rdf:type, and creating subClasses if necessary.
- Refinement of properties should be done by creating subproperties, if necessary.
- Extension is handled via RDF, by simply adding additional properties to the objects.
- Cardinalities are not useful to validate RDF data, like in the XML Schema implementations, but for the user to know which data structures he/she could be awaiting. The semantic units mandatory obligation in the Data Dictionary will not systematically be reflected as classes and properties cardinality.
- The names of the classes and predicates should follow best practice naming conventions. Classes should generally be initial upper case noun phrases (ClassOfThing), predicates should be initial lowercase verb phrases (hasSomeRelationship).
- RDF functionality that isn’t very widely supported or has the potential to conflict with local implementation, such as named graphs and reification, should be avoided.

Preservation Vocabularies Integration

Preservation vocabularies listed at http://id.loc.gov/vocabulary/preservation.html were originally created as controlled vocabularies associated with specific PREMIS semantic units.¹

Example: the values of the semantic unit messageDigestAlgorithm semantic unit² should be a controlled list. A controlled vocabulary proposed at http://id.loc.gov/vocabulary/preservation/cryptographicHashFunctions.html specifies a standard form for the most commonly expected values of this semantic unit.

The new version of the ontology assigns a key role to these vocabularies as they are intended to provide refinements of generic PREMIS elements defined in the ontology. Therefore members of each preservation vocabulary, which are now instances of SKOS Concept and MADS-RDF Topic, will be in a near future provided with additional assertions,

---

¹ Note that preservation vocabularies can be used in any expression of the PREMIS Data Dictionary, be it XML, RDF or relational database, and even by non-PREMIS implementations.
making them either subproperties, subclasses or instances of elements declared in the PREMIS ontology.

Example: members of the ‘cryptographic hash functions’ vocabulary mentioned above will be declared subclasses of `premis:Fixity`.

Should implementers feel the need for new elements in the preservation vocabularies, they can create their own and relate it to the corresponding ontology elements.

Example: an implementer who would need to specify that a Bitstream is located in an XML File, at a specific place indicated by its XML ID could create a `my:xmlIDref` class, and declare it subclass of `premis:StorageLocation`.

Note that if implementers consider their new term to be generic enough to serve the community, they may as well suggest that the PREMIS Editorial Committee add it.

External vocabularies

<table>
<thead>
<tr>
<th>Ontology</th>
<th>Prefix used in this document</th>
<th>Namespace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dublin Core Elements</td>
<td>dce</td>
<td><a href="http://purl.org/dc/elements/1.1/">http://purl.org/dc/elements/1.1/</a></td>
</tr>
<tr>
<td>Dublin Core Terms</td>
<td>dct</td>
<td><a href="http://purl.org/dc/terms/">http://purl.org/dc/terms/</a></td>
</tr>
<tr>
<td>EBU Core</td>
<td>ebucore</td>
<td><a href="https://www.ebu.ch/metadata/ontologies/ebucore#">https://www.ebu.ch/metadata/ontologies/ebucore#</a></td>
</tr>
<tr>
<td>Friend Of A Friend</td>
<td>foaf</td>
<td><a href="http://xmlns.com/foaf/spec/">http://xmlns.com/foaf/spec/</a></td>
</tr>
<tr>
<td>Open Digital Rights Language</td>
<td>odrl</td>
<td><a href="https://www.w3.org/ns/odrl/2/">https://www.w3.org/ns/odrl/2/</a></td>
</tr>
<tr>
<td>OWL 2 Web Ontology Language</td>
<td>owl</td>
<td><a href="http://www.w3.org/2002/07/owl#">http://www.w3.org/2002/07/owl#</a></td>
</tr>
<tr>
<td>Object Reuse and Exchange</td>
<td>ore</td>
<td><a href="http://www.openarchives.org/ore/terms">http://www.openarchives.org/ore/terms</a></td>
</tr>
<tr>
<td>PROV Ontology</td>
<td>prov</td>
<td><a href="http://www.w3.org/ns/prov#">http://www.w3.org/ns/prov#</a></td>
</tr>
<tr>
<td>RDF Schema</td>
<td>rdfs</td>
<td><a href="http://www.w3.org/TR/rdf-schema/">http://www.w3.org/TR/rdf-schema/</a></td>
</tr>
</tbody>
</table>
The following vocabularies are id.loc.gov preservation vocabularies

<table>
<thead>
<tr>
<th>Action Granted</th>
<th>acGranted</th>
<th>id.loc.gov/vocabulary/preservation/actionsGranted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent Type</td>
<td>agType</td>
<td>id.loc.gov/vocabulary/preservation/agentType</td>
</tr>
<tr>
<td>Content Location Type</td>
<td>contLocType</td>
<td>id.loc.gov/vocabulary/preservation/contentLocationType</td>
</tr>
<tr>
<td>Copyright Status</td>
<td>copStatus</td>
<td>id.loc.gov/vocabulary/preservation/copyrightStatus</td>
</tr>
<tr>
<td>Cryptographic Hash Functions</td>
<td>crypHashFunc</td>
<td>id.loc.gov/vocabulary/preservation/cryptographicHashFunctions</td>
</tr>
<tr>
<td>Environment Characteristic</td>
<td>envChar</td>
<td>id.loc.gov/vocabulary/preservation/environmentCharacteristic</td>
</tr>
<tr>
<td>Environment Function Type</td>
<td>envFuncType</td>
<td>id.loc.gov/vocabulary/preservation/environmentFunctionType</td>
</tr>
<tr>
<td>Environment Registry Role</td>
<td>envRegRole</td>
<td>id.loc.gov/vocabulary/preservation/environmentRegistryRole</td>
</tr>
<tr>
<td>Event Outcome</td>
<td>evOutcome</td>
<td>id.loc.gov/vocabulary/preservation/eventOutcome (not yet established)*</td>
</tr>
<tr>
<td>Event Related Agent Role</td>
<td>evRelAgRole</td>
<td>id.loc.gov/vocabulary/preservation/eventRelatedAgentRole</td>
</tr>
<tr>
<td>Event Related Object Role</td>
<td>evRelObjRole</td>
<td>id.loc.gov/vocabulary/preservation/eventRelatedObjectRole</td>
</tr>
<tr>
<td>Event Type</td>
<td>evType</td>
<td>id.loc.gov/vocabulary/preservation/eventType</td>
</tr>
<tr>
<td>Format Registry Role</td>
<td>forRegRole</td>
<td>id.loc.gov/vocabulary/preservation/formatRegistryRole</td>
</tr>
<tr>
<td>Functionality</td>
<td>func</td>
<td>id.loc.gov/vocabulary/preservation/functionality (not yet established)*</td>
</tr>
<tr>
<td>Inhibitor Type</td>
<td>inhibType</td>
<td>id.loc.gov/vocabulary/preservation/inhibitorType</td>
</tr>
<tr>
<td>Linking Environment Role</td>
<td>linkEnvRole</td>
<td>id.loc.gov/vocabulary/preservation/linkingEnvironmentRole</td>
</tr>
</tbody>
</table>

3 The URLs provided here are the landing pages of the Library of Congress vocabulary. To get the base URI for the prefix definition, users must add an ending slash character (“/”) at the end of these URLs.
The following vocabularies are used in examples

<table>
<thead>
<tr>
<th>Bibframe</th>
<th>bf</th>
<th><a href="http://id.loc.gov/ontologies/bibframe#">http://id.loc.gov/ontologies/bibframe#</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Common Data Model</td>
<td>pcdm</td>
<td><a href="http://pcdm.org/models#">http://pcdm.org/models#</a></td>
</tr>
<tr>
<td>Wikidata Entity</td>
<td>wd</td>
<td><a href="http://www.wikidata.org/entity/">http://www.wikidata.org/entity/</a></td>
</tr>
</tbody>
</table>

The prefix "my:" is used to introduce an example of locally defined class or property.

*See document Changes for id.loc.gov preservation voc

Conventions

Typographic conventions
The name of PREMIS semantic units is indicated using *italics*. RDF vocabularies are indicated using the **Courier New font**.

Example: "The *compositionLevel* semantic unit should be expressed through the `premis:hasCompositionLevel` property."
Diagram conventions
In the diagrams, resources are mentioned with a fictitious URI and the class they are instance of is indicated in **bold and italics** above the URI.

Instances of classes defined in the PREMIS ontology 3.0 are represented by gray ellipses, instances of locally defined classes are black ellipses, instances of classes or individuals defined at [http://id.loc.gov/vocabulary/preservation](http://id.loc.gov/vocabulary/preservation) are green ellipses, and individuals of classes defined in other ontologies are purple ellipses.

Examples:

**Identifier**

In RDF, defining an Identifier element is generally unnecessary, since the identifier of each Entity is the URI that is the subject of the triples. A URI being universally unique, its identifier type does not need to be specifically stated in a separate assertion.

Example:

```
<uriIdentifier1> a premis:representation .
```

*Fig. 1: Identifier as URI*

Nevertheless, **if the identifier value is a literal and not a URI**, the simplest approach is to use `dct:identifier` (or subproperties of it to indicate the identifier type)

Example:
Fig. 2: Using dct:Identifier

```
<uri1> a premis:Representation ;
   dct:identifier "1234" .
```

Note: a `premis:Identifier` class and a `premis:hasIdentifier` property are maintained, but should be used only
- if **additional information is required** (such as identifier status or administrative history);
- or to point to instances of classes from existing vocabularies that would use classes to define identifier types, e.g. [http://id.loc.gov/ontologies/bibframe#c.ISBN](http://id.loc.gov/ontologies/bibframe#c.ISBN).

Example 1: the identifier is a locally defined string, with additional assertions.

```
<uri1> a premis:Representation ;
   premis:hasIdentifier <identifier1> .
<identifier1> a my:localID ;
   dct:created "2016-12-04" ;
   rdf:value "0456" .
```

Fig. 3: Using locally defined identifiers with additional properties

```
<uri1> a premis:Representation ;
   premis:hasIdentifier <identifier1> .
<identifier1> a my:localID ;
   dct:created "2016-12-04" ;
   rdf:value "0456" .
```

Example 2: the identifier is an ISBN.

---

4 Note that there is no equivalent semantic unit in the PREMIS Data Dictionary. Properties to be attached to a `premis:Identifier` class are therefore entirely up to implementers.
Fig. 4: Using externally defined identifiers with additional properties

@prefix bf: <http://id.loc.gov/ontologies/bibframe#> .
<uri1> a premis:IntellectualEntity ;
    premis:hasIdentifier <identifier1> .
<identifier1> a bf:ISBN ;
    rdf:value "2-02-020908-X".

Relationships Between PREMIS Entities

Relationships between the four different PREMIS Entities (Object, Event, Agent and Rights) are expressed by the following semantic units: linkingEventIdentifier, linkingRightsStatementIdentifier, linkingAgentIdentifier, linkingObjectIdentifier and linkingEnvironmentIdentifier. Their mapping in RDF depends on the nature of the PREMIS entities they are binding.
Fig. 5: Relationships between PREMIS entities

Object to Event

PROV-O properties should be used to point from an instance of premis:Object to an instance of premis:Event. The prov:wasGeneratedBy property should be used if the Object was created by the Event. The prov:wasUsedBy property should be used if the Object pre-existed the Event.

Note: the alternative construct used to associate an Event to an Object by means of the relatedEventIdentifier\(^5\) semantic container should use the same construct in RDF, without regard to whether the Object is related to another Object through the Event or not.

Object to Rights

The dct:rights property should be used to point from an instance of premis:Object to an instance of premis:RightsBasis.

---

Event to Object

If the relationship from Event to Object must be stated, PROV-O properties `prov:generated` (inverse property of `prov:wasGeneratedBy`) and `prov:used` (inverse property of `prov:wasUsedBy`) should be used to point from an instance of `premis:Event` to an instance of `premis:Object`. If the Object role played in the Event is further specified by means of a linkingObjectRole semantic unit, locally defined subproperties of these PROV-O properties or those declared at id.loc.gov/vocabulary/preservation/eventRelatedObjectRole should be used.

Event to Agent

To express the relationship between Event and Agent the `prov:wasAssociatedWith` property should be used to point from an instance of `premis:Event` to an instance of `premis:Agent`. If the role played by the Agent in the Event is further specified by means of a linkingAgentRole semantic unit, subproperties of `prov:wasAssociatedWith` either declared at http://id.loc.gov/vocabulary/preservation/eventRelatedAgentRole or locally defined should be used.

Agent to Event

If the relationship from Agent to Event must be stated, the `prov:wasAssociateFor` PROV-O property (inverse property of `prov:wasAssociatedWith`) should be used.

Note that the relationship from an instance of `premis:Event` to an instance of `premis:Agent` should be preferred over this one, in particular because `prov:wasAssociateFor` is not an official PROV-O property.⁶

Rights to Agent

The relationship between Rights and Agent should be expressed through a `prov:wasInfluencedBy` property pointing from an instance of `premis:RightsBasis` to an instance of `premis:Agent`. If the role played in the definition of the rights basis by an Agent is further specified by means of a linkingAgentRole semantic unit, subproperties of `prov:wasInfluencedBy` either declared at http://id.loc.gov/vocabulary/preservation/rightsRelatedAgentRole or locally defined should be used.

Note: if users need to specify the Agent affected by the permission or prohibition expressed in the Rights Entity, a `prov:influenced` property may be used from an instance of `premis:Rule` to an instance of `premis:Agent`.

⁶ See https://www.w3.org/TR/prov-o/#inverse-names for more information about PROV-O inverse properties.
Agent to Object

If the Object is a Representation, a File or a Bitstream, the relSubType:isr property (is Represented By) should be used; if the Object is an Intellectual Entity, one of the skos:exactMatch / skos:closeMatch properties should be used depending on whether the described Agent corresponds exactly or partially to the Environment Object described in an Environment registry. If the Environment Object role is further specified by means of a linkingEnvironmentRole, subproperties of premis:hasRelationship either declared at id.loc.gov/vocabulary/preservation/linkingEnvironmentRole, or locally defined should be used.

Agent to Rights

If the relationship from Agent to Rights must be stated, a prov:influenced property should be used from an instance of premis:Agent to an instance of premis:RightsBasis.

Rights to Object

If the relationship from Rights to Object must be stated, the premis:governs property should be used to point from an instance of premis:RightsBasis to an instance of premis:Object.

Object

Object type (objectCategory)

Every PREMIS Object is an instance of one of the subclasses of the PREMIS Object abstract class. The class hierarchy is represented by the diagram below:

![Diagram of the class hierarchy of PREMIS Object types (objectCategory)](image)

Fig. 6: The four PREMIS object types (objectCategory)
Hence, the objectCategory is specified using rdf:type.

Example:

```xml
<premis:IntellectualEntity>
<exampleTheses>
</exampleTheses>
```
<file1> a premis:File;
   premis:hasPolicy <policy1> ;
   premis:hasPolicy <policy2> ;
   prov:wasUsedBy <event1> .

<policy1> a premis:PreservationPolicy;
   premis:hasNote "3 copies";
   premis:hasRationale "Bit-level preservation is currently..." .

<policy2> a premis:PreservationPolicy;
   premis:hasNote "normalization to uncompressed lpcm" .

<event1> a evType:PolicyAssignment;
   prov:generated <policy1> , <policy2> ;
   dct:date "2007-11-05T08:15:30-05:00".

**Significant Properties**

Significant properties are defined by the PREMIS Data Dictionary as "characteristics of a particular object subjectively determined to be important to maintain through preservation action". Thus, the `premis:SignificantProperties` class is declared a subclass of the `premis:PreservationPolicy` class. Instances of the `premis:SignificantProperties` class, attached to the Object thanks to a `premis:hasPolicy` property, are meant to point to one or several properties of the Object that should be considered significant, using the `rdfs:value` property. In the example below, `<File1>` and `<File2>` are formatted with bold and italics, and this property has been deemed significant. A Policy assignment Event records the date and time when a preservation policy, aiming at preserving the Objects formatting, was applied to these Objects. Note that `<File1>` has another property (frame rate) that was not deemed significant.

Significant properties can be shared and linked to from multiple objects when they are a general policy, or unique to a single object:

**Example:**
Fig. 8: Significant properties

<File1> a premis:File;
  premis:hasPolicy <sigProp1> ;
  prov:wasUsedBy <event1> ;
  ebucore:frameRate "25" ;
  my:hasBoldAndItalics "true" .

<File2> a premis:File ;
  premis:hasPolicy <SigProp1> ;
  prov:wasUsedBy <event1> ;
  my:hasBoldAndItalics "true" .

<SigProp1> a premis:SignificantProperties ;
  rdf:value <hasBoldAndItalics> .

<Event1> a evType:poa ;
  prov:generated <SigProp1> ;
  dct:date "2016-03-10T17:56:23Z" .

my:hasBoldAndItalics a rdfs:Property;
  rdfs:comment "Property indicating that the subject is formatted with bold and italics" .

Compound Objects (*compositionLevel*)

When an Object is compressed, encrypted or just packaged into a container file, each "layer" is described as a different premis:Object related to the others by means of properties either declared at [http://id.loc.gov/vocabulary/preservation/relationshipSubType](http://id.loc.gov/vocabulary/preservation/relationshipSubType) or locally defined subproperties of premis:hasRelationship. For a comprehensive description of
the way PREMIS defines compound Objects, see the "Object characteristics and composition level: the "onion" model" section page 256 of the Data Dictionary.\(^7\)

- The *compositionLevel* semantic unit is expressed by a `premis:hasCompositionLevel` property.
- Indicate the relationship between these different Objects, such as
  - `relSubType:cot` (compressed to) / `relSubType:cof` (compressed from) for compressed Objects; `relSubType:ent` (encrypted to) / `relSubType:enf` (encrypted from)
  - `relSubType:hsp` (has part) / `relSubType:isp` (is part of) for packaged Objects.

Example:

```
<file1> a premis:File ;
  premis:hasCompositionLevel "0" ;
  dct:format <pdfformat> ;
  premis:hasSize "500102" ;
  dct:creator <Acrobat> ;
  relSubType:cot <file2> .

<file2> a premis:File ;
  premis:hasCompositionLevel "1" ;
  dct:format <gzipformat> ;
  premis:hasSize "197452" ;
  dct:creator <unixGzip> ;
  relSubType:cof <file1> .
```

Fixity

- Fixity information is attached to the Object with a `premis:hasFixity` property having a range of `premis:Fixity`.
- The algorithm used to produce the message digest (`messageDigestAlgorithm` semantic unit) should be expressed using a subclass of `premis:Fixity` either declared at [http://id.loc.gov/vocabulary/preservation/cryptographicHashFunctions](http://id.loc.gov/vocabulary/preservation/cryptographicHashFunctions) or locally defined.
- The `messageDigest` itself is attached to the instance of `premis:Fixity` using the `rdf:value` property.
- The agent that is the creator of the message digest (`messageDigestOriginator`) is expressed by an instance of `prov:SoftwareAgent` attached by a `dct:creator` property to the instance of `premis:Fixity`.

**Note:** the `messageDigestOriginator` may also be declared as an implementer Agent (cf. [http://id.loc.gov/vocabulary/preservation/linkingAgentRoleEvent/imp](http://id.loc.gov/vocabulary/preservation/linkingAgentRoleEvent/imp)) involved in a message digest calculation Event (cf. [http://id.loc.gov/vocabulary/preservation/eventType/mes](http://id.loc.gov/vocabulary/preservation/eventType/mes)).

**Note:** implementers who would not want to specify URIs for the message digest originator may use `dce:creator` and mention it as a literal.

Example:

```
<file1> a premis:File ;
premis:hasFixity <file1fixity> ;
<file1fixity> a crypHashFunc:md5 ;
  rdf:value "258622b1683250cb519f3c0c1aefb7eb" ;
  dct:creator <GNUgperf31> .
```

**Fig. 10: Fixity information**

Size

To express the size of a File or a Bitstream, use `premis:hasSize`.

Example:

```
<file1> a premis:File ;
premis:hasSize "478347923" .
```
Format

- A Bitstream or File format is expressed through a `dct:format` property pointing to an instance of the `dct:FileFormat` class. This construct may be repeated if the Object complies with multiple format definitions.
  - Note: if specifying the format by a MIME type is deemed sufficient by implementers, the `ebucore:hasMimeType` property may be used in addition to or in replacement of the mentioned construct.
- The `formatName` semantic unit should be expressed through a `rdfs:label` property attached to the instance of `dct:FileFormat`.
- The `formatVersion` semantic unit should be expressed through a `premis:hasVersion` property attached to the instance of `dct:FileFormat`.
- The `formatNote` semantic unit should be expressed through a `premis:hasNote` property attached to the instance of `dct:FileFormat`.
- `formatRegistry` semantic units identify the same format in another registry, or a more generic definition of it. Depending on the degree of similarity between the two resources, either `skos:exactMatch` or `skos:closeMatch` should be used.
  - `formatRegistryRole`: if the registry role must be explicitly stated, properties defined at `id.loc.gov/vocabulary/preservation/formatRegistryRole` should be used, or subproperties of `skos:closeMatch` should be locally defined.
  - `formatRegistryName`: if the registry name must be explicitly stated, subproperties of `skos:exactMatch` or `skos:closeMatch` should be locally defined.

Example: 8

Fig. 11 File format information

8 The PRONOM resource stands for PDF/A-1b, so `skos:exactMatch` is used, whereas the LoC registry describes the more generic PDF/A-1, so `skos:closeMatch` is used.
<file1> a premis:File ;
   ebucore:hasMimeType "application/pdf" .
   dct:format <pdfa1bformat> .

<pdfa1bformat> a dct:FileFormat ;
   rdfs:label "Acrobat PDF/A-1b - Portable Document Format" ;
   premis:hasVersion "1b" ;
   premis:hasNote "Some note about PDF/A-1b" ;
   skos:exactMatch <http://www.nationalarchives.gov.uk/pronom/fmt/354> ;

Creating Application

Though describing an Object's creating application is preferably done by declaring an Agent related to a creation Event, the following constructs may alternatively be used by implementers, namely if the Event and Agent Entities are not supported.

- Creating application is represented by an instance of prov:SoftwareAgent related to the created Object by a dct:creator property.
- The dateCreatedByApplication semantic unit should be expressed through a prov:generatedAtTime property attached to the Object.
- The creatingApplicationName semantic unit should be expressed through an rdfs:label property attached to the instance of prov:SoftwareAgent.
  Note: implementers who would not want to specify URIs for the creating application may use dce:creator and mention the creating application name as a literal.
- The creatingApplicationVersion semantic unit should be expressed through a premis:hasVersion property attached to the instance of prov:SoftwareAgent.

Example:

```
"2016-05-10T14:23:30Z"
prov:generatedAtTime

"Adobe Distiller 15.0"
rdfs:label

"15.0"
premis:hasVersion
```

*Fig. 12: Using dct:creator to link a File to its creating application*

```
<file1> a premis:File ;
   dct:creator <distiller15> ;
```
Inhibitors

- Expressing features of the Object that could compromise preservation actions is done by declaring instances of subclasses of the abstract premis:Inhibitor class related to the Object by means of a premis:inhibitedBy property.
- Specifying the inhibitorType semantic unit is done by using subclasses of premis:Inhibitor, either declared at http://id.loc.gov/vocabulary/preservation/inhibitorType or locally defined.
- The inhibitorTarget semantic unit should be expressed by means of a premis:inhibits property related to the instance of premis:Inhibitor and pointing to an instance of premis:Functionality, either declared at http://id.loc.gov/vocabulary/preservation/functionality (not yet established) or locally defined.
- The inhibitorKey semantic unit is expressed by means of a premis:hasKey property related to the instance of premis:Inhibitor and pointing to a literal value of type xsd:String.

Note: Storing passwords or decryption keys is sometimes necessary, but raises security issues. Consider storing keys on offline media or printing them out, and referencing their location here.

Example:

```
<file1> a premis:File ;
  premis:inhibitedBy <file1inhibitor> .

<file1inhibitor> a inhibType:pas ;
  premis:inhibits func:all ;
  premis:hasKey "pr3ci0us" .
```
Original Name

Expressing the name of the Object as submitted to or harvested by the repository is expressed by means of a premis:hasOriginalName related to the Object and pointing to a literal value of type xsd:String.

Example:

```xml
<uri1> a premis:File ;
   premis:hasOriginalName "thesis.final.20160509.docx" .
```

Storage

- Storage information about an Object (be it a Representation, either digital or physical, a File or a Bitstream) should be expressed by a premis:storedAt property pointing from the Object to an instance of premis:StorageLocation.
- The means to reference the location of the content (the contentLocationType semantic unit) should be expressed by subclasses of premis:StorageLocation, either declared at http://id.loc.gov/vocabulary/preservation/contentLocationType or defined locally.
- The reference to the content location itself (the contentLocationValue semantic unit) should be expressed by the rdf:value property attached to the instance of premis:StorageLocation and pointing to a string (a filepath, a shelfmark, etc.).
- The storage medium on which the Object is preserved (the storageMedium semantic unit) is expressed by the premis:hasMedium property, pointing from the Object to an instance of premis:StorageLocation to an instance of premis:StorageMedium, either declared at http://id.loc.gov/vocabulary/preservation/storageMedium or defined locally.

Example:

```xml
<file1> a premis:File ;
   premis:storedAt [...
```

Fig. 14: Storage location information
Signature

- Signature information, which is used to authenticate the signer of an object and/or the information contained in the object, should be expressed by a `premis:hasSignature` property attached to an instance of `premis:File` or `premis:Bitstream` pointing to an instance of `premis:Signature`.
- The authority responsible for generating the signature, mentioned by a `signer` semantic unit, should be expressed by an Agent involved in a digital signature generation Event by means of an `evRelAgRole:imp` property. Note: Alternatively, if implementers do not use the Agent and Event Entities, it may be expressed by a `dce:creator` property attached to the instance of `premis:Signature` and pointing to a literal.
- The encryption and hash algorithm used to generate the signature, mentioned in a `signatureMethod` semantic unit, should be expressed by subclasses of `premis:Signature` either declared at `http://id.loc.gov/vocabulary/preservation/signatureMethod` or locally defined.
- The value generated from the application of a private key to a message digest, mentioned in a `signatureValue` semantic unit, should be expressed by an `rdf:value` property attached to the instance of `premis:Signature` and pointing to a literal.
- The public key used to verify that the signature value is valid (`keyInformation` semantic unit) should be expressed by a `premis:hasKey` property attached to the instance of `premis:Signature` and pointing to a literal.
- Information conveyed by the `signatureEncoding` semantic unit, i.e. encoding used for the values of `rdf:value` (`signatureValue`) and `premis:hasKey` (`keyInformation`), should be expressed by a `premis:hasEncoding` property attached to the instance of `premis:Signature` and pointing to an instance of `premis:SignatureEncoding`, either declared at `http://id.loc.gov/vocabulary/preservation/signatureEncoding` or locally defined.
- Operations to be performed in order to validate the digital signature (`signatureValidationRules` semantic unit) should be expressed by a `premis:hasValidationRules` property attached to an instance of `premis:Signature`. Note: this property is intended to point to a free-text description of the validation rules. If implementers need to point to a resource documenting the validation rules, they may use `premis:hasDocument` instead.
- Additional information about the generation of the signature (`signatureProperties` semantic unit) should be expressed either by properties of a digital signature generation Event (date, Agents involved, etc.) Note: implementers who would not implement the Event entity may use a `premis:hasNote` property attached to the instance of `premis:Signature`.

Example:
Environment

An Environment is any kind of technology (software, hardware or a combination of both) supporting an Object in some way (rendering, executing it, etc.). Given that an Object can be stored by a repository as a historical asset but considered an Environment by another repository, being an Environment is not an intrinsic characteristic of the Object. Therefore, an Object is not explicitly declared as Environment, but is considered as so if an Object declares a dependency relationship to it. Any category of Object can be considered an Environment; however, the following constructs are applicable only to Environments described as Intellectual Entities.
● The environmentFunction semantic container and its semantic units are expressed through subclasses of premis:IntellectualEntity, defined at id.loc.gov/vocabulary/preservation/environmentFunctionType.
● environmentName is expressed by the rdfs:label property.
● environmentVersion is expressed by a premis:hasVersion property.
● environmentOrigin mentions the producer of the Environment. It is expressed by a dct:creator property. The object of such property is expected to be an instance of foaf:Person or foaf:Organization.
● environmentDesignationNote is considered a free-text note about the Environment and thus expressed by a premis:hasNote property.
● environmentRegistry semantic units identify the same Environment in another registry. Depending on the degree of similarity between the two resources, either skos:exactMatch or skos:closeMatch should be used.
  ○ environmentRegistryRole: if the registry role must be explicitly stated, properties defined at id.loc.gov/vocabulary/preservation/environmentRegistryRole should be used, or subproperties of skos:closeMatch should be locally defined.
  ○ environmentRegistryName: if the registry name must be explicitly stated, subproperties of skos:exactMatch or skos:closeMatch should be locally defined.

1. Example: WordPerfect 5.1 for DOS

```
<environment1> a envFuncType:soa ;
   rdfs:label "WordPerfect 5.1 for DOS" ;
   premis:hasVersion "5.1" ;
   premis:hasNote "Some detail" ;
   dct:creator <WordPerfect Corporation> ;

<WordPerfect Corporation> a foaf:Organization .
```

Fig. 16 A software application described as an Environment
Relationships between Objects

Relationships between PREMIS Objects should be expressed by subproperties of the `premis:hasRelationship` property either declared at http://id.loc.gov/vocabulary/preservation/relationshipSubType or locally defined. In most cases, one of these properties is sufficient to express the nature of the relationship between two PREMIS Objects.

Example: a set of Files represents a digitized book.

```
<file1> a premis:File ;
  relSubType:isi <rep1> .
<file2> a premis:File ;
  relSubType:isi <rep1> .

<rep1> a premis:Representation ;
  relSubType:rep <IE1> .

<IE1> a premis:IntellectualEntity ;
  dct:title "Les Fleurs du mal" .
```

Example: a repository has a file from which it creates a derivative.

```
dct:FileFormat <tiffformat> ;
  evType:mig <event1> .
premis:File <file1> ;
  relSubType:has <file1> .
premis:File <file2> ;
  relSubType:iso <file1> .
```

Fig. 17: Relationships between Intellectual Entities, Representations and Files

Fig. 18: Relationship between a File and its derivative
For complex relationships involving Environments (particularly dependency relationships), a more complex structure is needed to specify the Environment purpose (which action the Environment is meant to perform on the Object) and characteristic (the extent to which the Environment support its purpose). An instance of premis:Dependency should in this case be created to bear premis:hasPurpose and premis:hasCharacteristic properties.

Example: a repository preserves WordPerfect for DOS files and uses PREMIS to model an environment stack for rendering the files.

Fig. 19: A rendering environment for a File
premis:hasPurpose func:all ;
premis:hasCharacteristic envChar:rec .

<WordPerfectForDos> a envFuncType:soa ;
relSubType:idp <MicrosoftDos> .

<MicrosoftDos> a envFuncType:ops ;
relSubType:req <dependency2> .

<dependency2> a premis:Dependency ;
relSubType:iem <vDos> ;
premis:hasCharacteristic envChar:kno .

<vDos> a envFuncType:soa ;
relSubType:idp <MicrosoftWindows> .

<MicrosoftWindows> a envFuncType:ops .

**Objects sequencing (relatedObjectSequence)**

Use edm:isNextInSequence. *(For aggregation-specific ordering, use ore:Proxy).*
Event

Event is one of the four PREMIS Entities. The corresponding `premis:Event` class is a subclass of `prov:Activity`.

- The `eventType` semantic unit should be expressed by subclasses of `premis:Event`, either declared at [http://id.loc.gov/vocabulary/preservation/eventType](http://id.loc.gov/vocabulary/preservation/eventType) or locally defined.
- The `eventDateTime` semantic unit should be expressed by `prov:startedAtTime` or `prov:endedAtTime` properties or both, if a date and time range has to be specified.
  Note: in the case where legacy data must be transformed into RDF and if the `eventDateTime` value cannot be determined as the beginning or the end of an Event, a `dct:date` property may be used to express `eventDateTime` instead of PROV-O properties.
- The `eventDetail` semantic unit is used to mention a free-text note about the Event. The property `premis:hasNote` should be used.
- The `eventOutcome` semantic unit is used to mention the Event result in a coded way. The property `premis:hasOutcome` should be attached to the Event and point to an individual of a `premis:OutcomeStatus` class, either declared at [http://id.loc.gov/vocabulary/preservation/eventOutcome](http://id.loc.gov/vocabulary/preservation/eventOutcome) (not yet established) or locally defined.
  Note: if the Event generated a non-PREMIS Object resource (a `premis:PreservationPolicy`, `premis:Signature`, `premis:Fixity`, etc.), implementers may use `prov:generated` to specify the relationship between the Event and this resource.
- The `eventOutcomeDetailNote` semantic unit provides additional free-text information about the Event outcome. It should be expressed through a `premis:hasOutcomeNote` property attached to the Event and pointing to a string value.

Example 1: a compression Event generating a compressed File with the 7zip tool.

---

9 See examples of this construct in sections on [Policy](#), [Signature](#) and [Significant properties](#) above.
Fig. 20: A compression Event

<event1> rdf:type evType:com ;
   dct:date "2017-01-21T01:46:16Z" ;
   premis:hasNote "[Compression parameters]" ;
   evRelObjRole:sou <uncompressed_file> ;
   evRelObjRole:out <compressed_file> ;
   evRelAgRole:imp <NRI> ;
   evRelAgRole:exe <7zip> .

<NRI> a premis:Organization .

<7zip> a premis:SoftwareAgent .

Example 2: an Event tracking metadata extraction from a file by Jhove

Fig. 21: A metadata extraction Event
<event2> rdf:type evType:mee ;
    prov:endedAtTime "2015-07-23T16:31:26.887+02:00" ;
    evRelAgRole:exe <jhove1_11> ;
    premis:hasOutcome evOutcome:com ;
    premis:hasOutcomeNote "Well-Formed and valid" .

<jhove1_11> a premis:SoftwareAgent .
Agent

Agent is one of the four PREMIS Entities. Its corresponding class, premis:Agent, is an abstract class, subclass of both foaf:Agent and prov:Agent.

- The agentType semantic unit should be expressed by subclasses of premis:Agent: premis:SoftwareAgent, premis:HardwareAgent, premis:Person or premis:Organization.
- The agentName semantic unit should be expressed by a foaf:name property for instances of premis:Organization and premis:Person, or rdfs:label for instances of premis:SoftwareAgent and premis:HardwareAgent.
- The agentVersion semantic unit should be expressed by a premis:hasVersion property.
- The agentNote semantic unit should be expressed by a premis:hasNote property.
- Note that the premis namespace is used for the agentType only when the Agent is connected to premis:Event, premis:RightsBasis or premis:Rule. If the Agent is attached to an Object as a creating application or to premis:Fixity using dct:creator, prov:SoftwareAgent is used instead.

Example:

```
<premis:HardwareAgent
<hardware1>
  rdfs:label "Bookeye 4"
  premis:hasVersion "V1A"
  premis:hasNote "serial number: 00073236706e"

<hardware1> a premis:HardwareAgent ;
  rdfs:label "Bookeye 4" ;
  premis:hasVersion "V1A" ;
  premis:hasNote "serial number: 00073236706e" .
```

Fig. 22: A hardware Agent
Rights

Unlike the three other PREMIS Entities, the Rights Entity has no equivalent class in RDF. Instead, the Rights Entity is represented by an instance of the `premis:RightsBasis` class and, optionally, by an instance of `premis:RightsStatus` expressing the status of the Object regarding the rights basis it is (or was) governed by.

For the relationship between Rights and Agent entities, see section "Rights to Agent" above.

Rights Basis

Specifying the rights basis of any rights statement is mandatory. The rights basis governing the Object should be expressed by a `dct:rights` property pointing to an instance of one of the subclasses of the `premis:RightsBasis` abstract class (`premis:Copyright`, `premis:Statute`, `premis:License`, `premis:InstitutionalPolicy` or a locally defined class for other types of rights basis).

- Applicable dates are specific to the Object affected by the rights basis. See the section Rights status below.
- If a free-text note about the rights basis must be added, a `premis:hasNote` property should be attached either to the instance of a subclass of the `premis:RightsBasis` class or to the instance of the `premis:RightsStatus` class, depending on whether the note applies to the rights basis or is specific to the Object.

Fig. 23: A model for the PREMIS Rights entity
● The jurisdiction to which the rights basis applies should be expressed by means of a `premis:hasJurisdiction` property attached to the instance of a subclass of the `premis:RightsBasis` class.

● Documentation concerning the rights basis should be expressed by means of a `premis:hasDocumentation` property pointing from an instance of `premis:RightsBasis` to an instance of `premis:Documentation`. If the documentation role has to be mentioned, implementers should define locally subproperties of `premis:hasDocumentation`.

● If the copyright status of the Object must be specified, subclasses of `premis:RightsStatus` should be used, either declared at `http://id.loc.gov/vocabulary/preservation/copyrightStatus` or locally defined.

● License terms should be expressed by means of a `premis:hasTerms` property attached to the instance of `premis:Licence`.

● Statute citation should be expressed by means of a `premis:hasCitation` property attached to the instance of `premis:Statute`.

● Implementers should define locally subclasses of the `premis:RightsBasis` class if the rights statement is not based on copyright, statute, license nor institutional policy.

Copyright example:

```
<rightsBasis1> a premis:Copyright ;
  premis:hasJurisdiction <http://ontologi.es/place/US> .
```

License example:

```
<rightsBasis2> a premis:Licence ;
  premis:hasDocumentation <documentation1> ;
  premis:hasTerms "Do not, under any circumstances, etc." .
```

Statute example:

```
<rightsBasis3> a premis:Statute ;
  premis:hasJurisdiction <http://ontologi.es/place/DE> ;
  premis:hasCitation "Gesetz über die deutsche Nationalbibliothek vom 22. Juni 2006(DNBG)" ;
  premis:hasNote "Legal Deposit Law in Germany" .
```

Institutional policy example:

```
<rightsBasis4> a premis:InstitutionalPolicy ;
  premis:hasNote "80-year rule" ;
  prov:wasInfluencedBy <hul> .
```

Note: in the case a rights statement defined at `rightsstatements.org/` applies to an Object, such rights statement may replace an instance of `premis:RightsBasis` and be the basis of any permission or prohibition.

Example:

```
<obj3> dct:rights <http://rightsstatements.org/vocab/InC/1.0/> .

<http://rightsstatements.org/vocab/InC/1.0/> a premis:Copyright .
```
Rights status

If the Object status regarding the rights basis has to be specified, an instance of premis:RightsStatus should be attached to the Object by means of a premis:hasRightsStatus property. It may be necessary to specify the relationship between the status and the rights basis, especially in the case of multiple rights basis affecting simultaneously or successively the Object; in such case, a premis:hasBasis property should point from the instance of premis:RightsStatus to the instance of premis:RightsBasis.

- Applicable dates should be mentioned by means of premis:startDate and premis:endDate properties attached to the instance of premis:RightsStatus. Note: though the use of standard conventions like ISO 8601 is recommended to express date and time values, the range of premis:startDate and premis:endDate is defined to be rdfs:Literal to accommodate uncertainty and open dates.¹⁰
- The status determination date should be specified by means of a premis:hasDeterminationDate attached to the instance of premis:RightsStatus.

Example:

Fig. 24: The rights status of an Intellectual Entity

```
<object1> a premis:IntellectualEntity ;
  dct:rights <rightsBasis1> ;
  premis:hasRightsStatus [ a premis:RightsStatus ;
    premis:startDate "2005-05-29" ;
    premis:endDate "OPEN" ;
  ] ;

premis:RightsStatus _:nodeID0001
```

¹⁰ For a standard expression of uncertain or open dates, see the Extended Date/Time Format (http://www.loc.gov/standards/datetime/).
Rule (*rightsGranted*)

The *premis:Rule* class represents either a permission or a prohibition to perform an action. An instance of *premis:Rule* is attached to an instance of *premis:RightsBasis* by means of a *premis:allows* or *premis:prohibits* property, depending on whether the action is allowed or prohibited to the repository or to an Agent.

- The *rightsGrantedNote* semantic unit should be expressed by a *premis:hasNote* property attached to the instance of *premis:Rule*.
- The rule applicable dates (the *termOfGrant* semantic unit) should be expressed by means of *premis:startDate* and *premis:endDate* properties attached to the instance of *premis:Rule*.
- The action allowed or prohibited by the rule should be expressed by a *premis:act* property pointing to an instance of *premis:Action*, either declared at [http://id.loc.gov/vocabulary/preservation/actionsGranted](http://id.loc.gov/vocabulary/preservation/actionsGranted) or locally defined.
- Other restrictions than the rule applicable dates applying to the permission or prohibition should be expressed by the *odrl:constraint* property pointing to an instance of *odrl:Constraint*.

Note: however, if the restriction cannot be expressed by the ODRL vocabulary or in the case of a mapping from XML legacy data to RDF, a *premis:hasRestriction* property may be used to attach a free-text description of the restriction to the instance of *premis:Rule*.

Example 1 (an institutional policy allowing <agent1> to reproduce, modify and migrate an Object, but prohibiting its use for 80 years):

![Fig. 25: Attaching Rules to a RightsBasis](image-url)

---

11 See [https://www.w3.org/TR/odrl-model/#constraint](https://www.w3.org/TR/odrl-model/#constraint) for further information about ODRL Constraints.
Example 2 (a license granted by <agent1> allowing the repository to make only 3 copies of the Object for preservation purposes):

<rightsBasis6> a premis:License ;
  rightsRelAgRole:gra <agent1> ;
  premis:allows <rule1> .

<rule1> a premis:Rule ;
  premis:act acGranted:rep ;
  odlr:constraint [ a odlr:Constraint ;
    odlr:leftOperand odlr:count ;
    odlr:operator odlr:lteq ;
    odlr:rightOperand "3" ] .

Fig. 26: Using Open Digital Rights Language (ODRL) to further refine a Rule
<agent1> a premis:Person .