W3C Editor's Draft

XML Serialization

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Abstract

OWL 2 extends the W3C OWL Web Ontology Language with a small but useful set of features that have been requested by users, for which effective reasoning algorithms are now available, and that OWL tool developers are willing to support. The new features include extra syntactic sugar, additional property and qualified cardinality constructors, extended datatype support, simple metamodeling, and extended annotations.
This document specifies an XML syntax for OWL 2 that mirrors its structural specification. An XML schema defines this syntax and is available as a separate document, as well as being included here.

W3C Editor's Draft

Status of this Document

May Be Superseded

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Set of Documents

This document is being published as one of a set of 11 documents:

1. Structural Specification and Functional-Style Syntax
2. Direct Semantics
3. RDF-Based Semantics
4. Conformance and Test Cases
5. Mapping to RDF Graphs
6. XML Serialization (this document)
7. Profiles
8. Quick Reference Guide
9. New Features and Rationale
10. Manchester Syntax
11. rdf:text: A Datatype for Internationalized Text

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Contents

1 Overview (Normative)

This document defines the XML syntax for OWL 2. This syntax mirrors the structural specification of OWL 2 [*OWL 2 Specification*] and is defined by means of an XML schema [*XML Schema*], which is available as part of this document. The XML schema has been obtained by a straightforward translation of the structural specification of the OWL 2 Specification [*OWL 2 Specification*] in the following way:

- Each UML class that is intended to be instantiated is mapped to a global element, whose elements and attributes correspond to the components of the UML class.
- Each UML class that is not intended to be instantiated directly, but instead gathers together commonalities, is mapped to a global element group, whose choice members correspond to the children of the UML class.

The elements in the XML Schema belong to the *owl* namespace, and the attributes have no namespace. The local parts of the names used in the XML Schema are the same as the names of their corresponding elements from the structural specification.

The XML schema thus captures the structure of OWL 2 entities, expressions, and axioms. Certain global conditions on OWL 2 ontologies, such as the ones described in Sections 5.8.1 and 11 of the OWL 2 Specification [*OWL 2 Specification*], cannot be captured in an XML schema. Tools parsing OWL 2 ontologies in this syntax need to additionally implement these global conditions.

The XML syntax of OWL 2 corresponds closely to the structural specification of OWL 2, so it is fully typed. It thus differs somewhat from the functional-style syntax

of OWL 2 [*OWL 2 Specification*]. For example, whereas the functional-style syntax uses a nonterminal `SomeValuesFrom` for existential restrictions on both the object and data properties, the XML syntax provides two elements `owl:ObjectSomeValuesFrom` and `owl:DataSomeValuesFrom`.

Each axiom in the XML syntax of OWL 2 contains complete information about the type of all the entities in it. Therefore the OWL 2 XML Syntax can be parsed more easily than by using the canonical parsing process from Section 3.6 of OWL 2 Specification [*OWL 2 Specification*]. Nonetheless, each OWL 2 ontology written in the XML syntax of OWL 2 *must* satisfy the typing constraints from Section 5.8.1 of the OWL 2 Specification [*OWL 2 Specification*] — that is, declarations for ontology entities *must* be present in the import closure of the ontology as required even if the type of ontology elements can be inferred from the axioms.

During parsing of ontology documents written in the XML syntax of OWL 2, all values that are declared in the schema given below as being of type *xsd:anyURI* *must* be resolved against the respective *base URI* as specified in the XML Base specification [*XML Base*]. This expansion is handled at the XML level during parsing, and the structural specification of OWL 2 makes no provisions for keeping track of the base URIs of ontology entities and axioms. The base URI of the `owl:Ontology` element is completely independent from the ontology and/or the version URI of the ontology and its value *must* be determined exactly as specified in the XML Base specification. Furthermore, just like all other URIs, the values of the `ontologyURI` and/or `versionURI` attributes of the `owl:Ontology` element *must* be resolved against the base URI of the `owl:Ontology` element. In contrast, OWL 2 literals of the *xsd:anyURI* datatype *must not* be resolved against the base URI: all literals of OWL 2 are treated as opaque values whose value is fully defined by their lexical representation.

The XML schema presented here covers the entire OWL 2 structural specification, and thus includes all the features available in OWL 2 profiles [*OWL 2 Profiles*]. There are no separate schemata for these profiles — that is, ontologies that can be expressed by the profiles *must* be written using the most general schema. Validating whether an ontology belongs to a particular profile is not intended to be performed using XML schema mechanisms, so the specification of such mechanisms is beyond the scope of this document.

An *XML syntax ontology document* is a sequence of octets accessible from some URI by means of the standard protocols that can be parsed into an XML document, that conforms to the XML schema defined in this document, and that can be converted into an OWL 2 ontology as specified earlier.

The italicized keywords *must*, *must not*, *should*, *should not*, and *may* specify certain aspects of the normative behavior of OWL 2 tools, and are interpreted as specified in RFC 2119 [*RFC 2119*].

Editor's Note: OWL WG [issue 97] involves GRDDL transforms from the XML serialization. Its resolution may affect this document.

2 Example Ontology (Informative)

Example:

The following is an example of an OWL 2 ontology written in XML syntax. More examples can be found in the OWL 2 Primer [*OWL 2 Primer*].

```
<?xml version="1.0" encoding="UTF-8"?>
<owl:Ontology xmlns:xsi="http://www.w3.org/2001/
XMLSchema-instance"
    xsi:schemaLocation="http://www.w3.org/ns/owl2-xml
http://www.w3.org/ns/owl2-xml/live-from-wiki.xsd"
    xmlns:owl="http://www.w3.org/2002/07/owl#"
    xml:base="http://example.com/myOntology"
    owl:ontologyURI="http://example.com/myOntology">

    <owl:Import>http://example.com/
someOtherOntology</owl:Import>

    <owl:Declaration>
       <owl:Class URI="#animal"/>
    </owl:Declaration>
    <owl:Declaration>
       <owl:Class URI="#tabloid"/>
    </owl:Declaration>
    <owl:Declaration>
       <owl:ObjectProperty URI="#eats"/>
    </owl:Declaration>
    <owl:Declaration>
       <owl:ObjectProperty URI="#reads"/>
    </owl:Declaration>

    <owl:SubClassOf>
       <owl:Class URI="#animal"/>
       <owl:ObjectAllValuesFrom>
          <owl:ObjectProperty URI="#reads"/>
          <owl:Class URI="#tabloid"/>
       </owl:ObjectAllValuesFrom>
    </owl:SubClassOf>

</owl:Ontology>
```

3 The XML Schema (Normative)

```
<xsd:schema
 xmlns:xsd="http://www.w3.org/2001/XMLSchema"
 xmlns:owl="http://www.w3.org/2002/07/owl#"
 targetNamespace="http://www.w3.org/2002/07/owl#"
 elementFormDefault="qualified" attributeFormDefault="unqualified">

<xsd:import namespace="http://www.w3.org/XML/1998/namespace" schemaLocation

<!-- The ontology -->

<xsd:element name="Import">
  <xsd:complexType>
    <xsd:simpleContent>
      <xsd:extension base="xsd:anyURI">
        <xsd:attributeGroup ref="xml:specialAttrs"/>
      </xsd:extension>
    </xsd:simpleContent>
  </xsd:complexType>
</xsd:element>

<xsd:element name="Ontology">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="owl:Import" minOccurs="0" maxOccurs="unbounded"/>
      <xsd:group ref="owl:ontologyAnnotations"/>
      <xsd:group ref="owl:Axiom" minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="ontologyURI" type="xsd:anyURI" use="optional"/>
    <xsd:attribute name="versionURI" type="xsd:anyURI" use="optional"/>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<!-- Entities, anonymous individuals, and literals -->

<xsd:group name="Entity">
  <xsd:choice>
    <xsd:element ref="owl:Class"/>
    <xsd:element ref="owl:Datatype"/>
    <xsd:element ref="owl:ObjectProperty"/>
    <xsd:element ref="owl:DataProperty"/>
    <xsd:element ref="owl:AnnotationProperty"/>
    <xsd:element ref="owl:NamedIndividual"/>
  </xsd:choice>
</xsd:group>
```

```
<xsd:element name="Class">
  <xsd:complexType>
    <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="Datatype">
  <xsd:complexType>
    <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectProperty">
  <xsd:complexType>
    <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataProperty">
  <xsd:complexType>
    <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="AnnotationProperty">
  <xsd:complexType>
    <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:group name="Individual">
  <xsd:choice>
    <xsd:element ref="owl:NamedIndividual"/>
    <xsd:element ref="owl:AnonymousIndividual"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="NamedIndividual">
  <xsd:complexType>
    <xsd:attribute name="URI" type="xsd:anyURI" use="required"/>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
```

```
</xsd:element>

<xsd:element name="AnonymousIndividual">
  <xsd:complexType>
    <xsd:attribute name="nodeID" type="xsd:NCName" use="required"/>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="Literal">
 <xsd:complexType>
   <xsd:simpleContent>
     <xsd:extension base="xsd:string">
       <xsd:attribute name="datatypeURI" type="xsd:anyURI"/>
       <xsd:attributeGroup ref="xml:specialAttrs"/>
     </xsd:extension>
   </xsd:simpleContent>
 </xsd:complexType>
</xsd:element>

<!-- Declarations -->

<xsd:element name="Declaration">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:Entity"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<!-- Object property expressions -->

<xsd:group name="ObjectPropertyExpression">
  <xsd:choice>
    <xsd:element ref="owl:ObjectProperty"/>
    <xsd:element ref="owl:InverseObjectProperty"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="InverseObjectProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="owl:ObjectProperty"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
```

```
</xsd:element>

<!-- Data property expressions -->

<xsd:group name="DataPropertyExpression">
  <xsd:sequence>
    <xsd:element ref="owl:DataProperty"/>
  </xsd:sequence>
</xsd:group>

<!-- Data ranges -->

<xsd:group name="DataRange">
  <xsd:choice>
    <xsd:element ref="owl:Datatype"/>
    <xsd:element ref="owl:DataIntersectionOf"/>
    <xsd:element ref="owl:DataUnionOf"/>
    <xsd:element ref="owl:DataComplementOf"/>
    <xsd:element ref="owl:DataOneOf"/>
    <xsd:element ref="owl:DatatypeRestriction"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="DataIntersectionOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataRange" minOccurs="2" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataUnionOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataRange" minOccurs="2" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataComplementOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataRange"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
```

```
</xsd:element>

<xsd:element name="DataOneOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="owl:Literal" minOccurs="1" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DatatypeRestriction">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="owl:Datatype"/>
      <xsd:element name="FacetRestriction" minOccurs="1" maxOccurs="unbound
        <xsd:complexType>
          <xsd:sequence>
            <xsd:element ref="owl:Literal"/>
          </xsd:sequence>
          <xsd:attribute name="facet" type="xsd:anyURI" use="required"/>
        </xsd:complexType>
      </xsd:element>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<!-- Class expressions -->

<xsd:group name="ClassExpression">
  <xsd:choice>
    <xsd:element ref="owl:Class"/>
    <xsd:element ref="owl:ObjectIntersectionOf"/>
    <xsd:element ref="owl:ObjectUnionOf"/>
    <xsd:element ref="owl:ObjectComplementOf"/>
    <xsd:element ref="owl:ObjectOneOf"/>
    <xsd:element ref="owl:ObjectSomeValuesFrom"/>
    <xsd:element ref="owl:ObjectAllValuesFrom"/>
    <xsd:element ref="owl:ObjectHasValue"/>
    <xsd:element ref="owl:ObjectHasSelf"/>
    <xsd:element ref="owl:ObjectMinCardinality"/>
    <xsd:element ref="owl:ObjectMaxCardinality"/>
    <xsd:element ref="owl:ObjectExactCardinality"/>
    <xsd:element ref="owl:DataSomeValuesFrom"/>
    <xsd:element ref="owl:DataAllValuesFrom"/>
    <xsd:element ref="owl:DataHasValue"/>
    <xsd:element ref="owl:DataMinCardinality"/>
```

```
    <xsd:element ref="owl:DataMaxCardinality"/>
    <xsd:element ref="owl:DataExactCardinality"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="ObjectIntersectionOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ClassExpression" minOccurs="2" maxOccurs="unbound
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectUnionOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ClassExpression" minOccurs="2" maxOccurs="unbound
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectComplementOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ClassExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectOneOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:Individual" minOccurs="1" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectSomeValuesFrom">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:ClassExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
```

```
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectAllValuesFrom">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:ClassExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectHasValue">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:Individual"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectHasSelf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectMinCardinality">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:ClassExpression" minOccurs="0" maxOccurs="1"/>
    </xsd:sequence>
    <xsd:attribute name="cardinality" type="xsd:nonNegativeInteger" use="re
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectMaxCardinality">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:ClassExpression" minOccurs="0" maxOccurs="1"/>
```

```
    </xsd:sequence>
    <xsd:attribute name="cardinality" type="xsd:nonNegativeInteger" use="re
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectExactCardinality">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:ClassExpression" minOccurs="0" maxOccurs="1"/>
    </xsd:sequence>
    <xsd:attribute name="cardinality" type="xsd:nonNegativeInteger" use="re
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataSomeValuesFrom">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataPropertyExpression" minOccurs="1" maxOccurs="
      <xsd:group ref="owl:DataRange"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataAllValuesFrom">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataPropertyExpression" minOccurs="1" maxOccurs="
      <xsd:group ref="owl:DataRange"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataHasValue">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataPropertyExpression"/>
      <xsd:element ref="owl:Literal"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataMinCardinality">
```

```
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataPropertyExpression"/>
      <xsd:group ref="owl:DataRange" minOccurs="0" maxOccurs="1"/>
    </xsd:sequence>
    <xsd:attribute name="cardinality" type="xsd:nonNegativeInteger" use="re
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataMaxCardinality">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataPropertyExpression"/>
      <xsd:group ref="owl:DataRange" minOccurs="0" maxOccurs="1"/>
    </xsd:sequence>
    <xsd:attribute name="cardinality" type="xsd:nonNegativeInteger" use="re
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataExactCardinality">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:DataPropertyExpression"/>
      <xsd:group ref="owl:DataRange" minOccurs="0" maxOccurs="1"/>
    </xsd:sequence>
    <xsd:attribute name="cardinality" type="xsd:nonNegativeInteger" use="re
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<!-- Axioms -->

<xsd:group name="Axiom">
  <xsd:choice>
    <xsd:element ref="owl:Declaration"/>
    <xsd:group ref="owl:ClassAxiom"/>
    <xsd:group ref="owl:ObjectPropertyAxiom"/>
    <xsd:group ref="owl:DataPropertyAxiom"/>
    <xsd:element ref="owl:HasKey"/>
    <xsd:group ref="owl:Assertion"/>
    <xsd:group ref="owl:AnnotationAxiom"/>
  </xsd:choice>
</xsd:group>

<!-- Class expression axioms -->
```

```
<xsd:group name="ClassAxiom">
  <xsd:choice>
    <xsd:element ref="owl:SubClassOf"/>
    <xsd:element ref="owl:EquivalentClasses"/>
    <xsd:element ref="owl:DisjointClasses"/>
    <xsd:element ref="owl:DisjointUnion"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="SubClassOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ClassExpression"/> <!-- This is the subexpression
      <xsd:group ref="owl:ClassExpression"/> <!-- This is the superexpressi
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="EquivalentClasses">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ClassExpression" minOccurs="2" maxOccurs="unbound
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DisjointClasses">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ClassExpression" minOccurs="2" maxOccurs="unbound
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DisjointUnion">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:element ref="owl:Class"/>
      <xsd:group ref="owl:ClassExpression" minOccurs="2" maxOccurs="unbound
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
```

```
  </xsd:complexType>
</xsd:element>

<!-- Object property axioms -->

<xsd:group name="ObjectPropertyAxiom">
  <xsd:choice>
    <xsd:element ref="owl:SubObjectPropertyOf"/>
    <xsd:element ref="owl:EquivalentObjectProperties"/>
    <xsd:element ref="owl:DisjointObjectProperties"/>
    <xsd:element ref="owl:InverseObjectProperties"/>
    <xsd:element ref="owl:ObjectPropertyDomain"/>
    <xsd:element ref="owl:ObjectPropertyRange"/>
    <xsd:element ref="owl:FunctionalObjectProperty"/>
    <xsd:element ref="owl:InverseFunctionalObjectProperty"/>
    <xsd:element ref="owl:ReflexiveObjectProperty"/>
    <xsd:element ref="owl:IrreflexiveObjectProperty"/>
    <xsd:element ref="owl:SymmetricObjectProperty"/>
    <xsd:element ref="owl:AsymmetricObjectProperty"/>
    <xsd:element ref="owl:TransitiveObjectProperty"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="SubObjectPropertyOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:choice> <!-- This is the subproperty expression or the property
        <xsd:group ref="owl:ObjectPropertyExpression"/>
        <xsd:element name="PropertyChain">
          <xsd:complexType>
            <xsd:sequence>
              <xsd:group ref="owl:ObjectPropertyExpression" minOccurs="2" m
            </xsd:sequence>
            <xsd:attributeGroup ref="xml:specialAttrs"/>
          </xsd:complexType>
        </xsd:element>
      </xsd:choice>
      <xsd:group ref="owl:ObjectPropertyExpression"/> <!-- This is the supe
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="EquivalentObjectProperties">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
```

```
      <xsd:group ref="owl:ObjectPropertyExpression" minOccurs="2" maxOccurs
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DisjointObjectProperties">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression" minOccurs="2" maxOccurs
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectPropertyDomain">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:ClassExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectPropertyRange">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:ClassExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="InverseObjectProperties">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression" minOccurs="2" maxOccurs
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>
```

```
<xsd:element name="FunctionalObjectProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="InverseFunctionalObjectProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ReflexiveObjectProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="IrreflexiveObjectProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="SymmetricObjectProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
```

```
</xsd:element>

<xsd:element name="AsymmetricObjectProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="TransitiveObjectProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<!-- Data property axioms -->

<xsd:group name="DataPropertyAxiom">
  <xsd:choice>
    <xsd:element ref="owl:SubDataPropertyOf"/>
    <xsd:element ref="owl:EquivalentDataProperties"/>
    <xsd:element ref="owl:DisjointDataProperties"/>
    <xsd:element ref="owl:DataPropertyDomain"/>
    <xsd:element ref="owl:DataPropertyRange"/>
    <xsd:element ref="owl:FunctionalDataProperty"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="SubDataPropertyOf">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:DataPropertyExpression"/> <!-- This is the subpro
      <xsd:group ref="owl:DataPropertyExpression"/> <!-- This is the superp
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="EquivalentDataProperties">
  <xsd:complexType>
```

```
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:DataPropertyExpression" minOccurs="2" maxOccurs="
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DisjointDataProperties">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:DataPropertyExpression" minOccurs="2" maxOccurs="
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataPropertyDomain">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:DataPropertyExpression"/>
      <xsd:group ref="owl:ClassExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataPropertyRange">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:DataPropertyExpression"/>
      <xsd:group ref="owl:DataRange"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="FunctionalDataProperty">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:DataPropertyExpression"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
```

```
</xsd:element>

<!-- Key axioms -->

<xsd:element name="HasKey">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ClassExpression"/>
      <xsd:choice minOccurs="1" maxOccurs="unbounded">
        <xsd:group ref="owl:ObjectPropertyExpression"/>
        <xsd:group ref="owl:DataPropertyExpression"/>
      </xsd:choice>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<!-- Assertions -->

<xsd:group name="Assertion">
  <xsd:choice>
    <xsd:element ref="owl:SameIndividual"/>
    <xsd:element ref="owl:DifferentIndividuals"/>
    <xsd:element ref="owl:ClassAssertion"/>
    <xsd:element ref="owl:ObjectPropertyAssertion"/>
    <xsd:element ref="owl:NegativeObjectPropertyAssertion"/>
    <xsd:element ref="owl:DataPropertyAssertion"/>
    <xsd:element ref="owl:NegativeDataPropertyAssertion"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="SameIndividual">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:Individual" minOccurs="2" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DifferentIndividuals">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:Individual" minOccurs="2" maxOccurs="unbounded"/>
    </xsd:sequence>
```

```
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ClassAssertion">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ClassExpression"/>
      <xsd:group ref="owl:Individual"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="ObjectPropertyAssertion">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:Individual"/> <!-- This is the source invididual
      <xsd:group ref="owl:Individual"/> <!-- This is the target individual
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="NegativeObjectPropertyAssertion">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:ObjectPropertyExpression"/>
      <xsd:group ref="owl:Individual"/> <!-- This is the source invididual
      <xsd:group ref="owl:Individual"/> <!-- This is the target individual
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="DataPropertyAssertion">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:DataPropertyExpression"/>
      <xsd:group ref="owl:Individual"/> <!-- This is the source invididual
      <xsd:element ref="owl:Literal"/> <!-- This is the target value -->
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
```

```
  </xsd:complexType>
</xsd:element>

<xsd:element name="NegativeDataPropertyAssertion">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:group ref="owl:DataPropertyExpression"/>
      <xsd:group ref="owl:Individual"/> <!-- This is the source invididual
      <xsd:element ref="owl:Literal"/> <!-- This is the target value -->
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<!-- Annotations  -->

<xsd:element name="URI">
  <xsd:complexType>
    <xsd:simpleContent>
      <xsd:extension base="xsd:anyURI">
        <xsd:attributeGroup ref="xml:specialAttrs"/>
      </xsd:extension>
    </xsd:simpleContent>
  </xsd:complexType>
</xsd:element>

<xsd:group name="AnnotationSubject">
  <xsd:choice>
    <xsd:element ref="owl:URI"/>
    <xsd:element ref="owl:AnonymousIndividual"/>
  </xsd:choice>
</xsd:group>

<xsd:group name="AnnotationValue">
  <xsd:choice>
    <xsd:element ref="owl:URI"/>
    <xsd:element ref="owl:AnonymousIndividual"/>
    <xsd:element ref="owl:Literal"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="Annotation">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:annotationAnnotations"/>
      <xsd:element ref="owl:AnnotationProperty"/>
      <xsd:group ref="owl:AnnotationValue"/>
```

```
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:group name="axiomAnnotations">
  <xsd:sequence>
    <xsd:element ref="owl:Annotation" minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:group>

<xsd:group name="ontologyAnnotations">
  <xsd:sequence>
    <xsd:element ref="owl:Annotation" minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:group>

<xsd:group name="annotationAnnotations">
  <xsd:sequence>
    <xsd:element ref="owl:Annotation" minOccurs="0" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:group>

<!-- Annotation axioms -->

<xsd:group name="AnnotationAxiom">
  <xsd:choice>
    <xsd:element ref="owl:AnnotationAssertion"/>
    <xsd:element ref="owl:SubAnnotationPropertyOf"/>
    <xsd:element ref="owl:AnnotationPropertyDomain"/>
    <xsd:element ref="owl:AnnotationPropertyRange"/>
  </xsd:choice>
</xsd:group>

<xsd:element name="AnnotationAssertion">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:group ref="owl:axiomAnnotations"/>
      <xsd:element ref="owl:AnnotationProperty"/>
      <xsd:group ref="owl:AnnotationSubject"/>
      <xsd:group ref="owl:AnnotationValue"/>
    </xsd:sequence>
    <xsd:attributeGroup ref="xml:specialAttrs"/>
  </xsd:complexType>
</xsd:element>

<xsd:element name="SubAnnotationPropertyOf">
  <xsd:complexType>
```

```
      <xsd:sequence>
        <xsd:group ref="owl:axiomAnnotations"/>
        <xsd:element ref="owl:AnnotationProperty"/> <!-- This is the subprope
        <xsd:element ref="owl:AnnotationProperty"/> <!-- This is the superpro
      </xsd:sequence>
      <xsd:attributeGroup ref="xml:specialAttrs"/>
    </xsd:complexType>
  </xsd:element>

  <xsd:element name="AnnotationPropertyDomain">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:group ref="owl:axiomAnnotations"/>
        <xsd:element ref="owl:AnnotationProperty"/>
        <xsd:element ref="owl:URI"/>
      </xsd:sequence>
      <xsd:attributeGroup ref="xml:specialAttrs"/>
    </xsd:complexType>
  </xsd:element>

  <xsd:element name="AnnotationPropertyRange">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:group ref="owl:axiomAnnotations"/>
        <xsd:element ref="owl:AnnotationProperty"/>
        <xsd:element ref="owl:URI"/>
      </xsd:sequence>
      <xsd:attributeGroup ref="xml:specialAttrs"/>
    </xsd:complexType>
  </xsd:element>

  </xsd:schema>
```

4 Appendix: Internet Media Type, File Extension, and Macintosh File Type

Contact

Sandro Hawke

See also

How to Register a Media Type for a W3C Specification Internet Media Type registration, consistency of use TAG Finding 3 June 2002 (Revised 4 September 2002)

The Internet Media Type / MIME Type for the OWL XML Serialization is `application/owl+xml`.

It is recommended that OWL XML Serialization files have the extension `.owx` (all lowercase) on all platforms.

It is recommended that OWL XML Serialization files stored on Macintosh HFS file systems be given a file type of `TEXT`.

The information that follows will be submitted to the IESG for review, approval, and registration with IANA.

Type name
application
Subtype name
owl+xml
Required parameters
None
Optional parameters
charset This parameter may be required when transfering non-ascii data across some protocols.
Encoding considerations
The syntax of the OWL XML Serialization is expressed over code points in Unicode [*UNICODE*].
Security considerations
The OWL XML Serialization uses IRIs as term identifiers. Applications interpreting data expressed in the OWL XML Serialization should address the security issues of Internationalized Resource Identifiers (IRIs) [*RFC3987*] Section 8, as well as Uniform Resource Identifiers (URI): Generic Syntax [*RFC3986*] Section 7. Multiple IRIs may have the same appearance. Characters in different scripts may look similar (a Cyrillic "o" may appear similar to a Latin "o"). A character followed by combining characters may have the same visual representation as another character (LATIN SMALL LETTER E followed by COMBINING ACUTE ACCENT has the same visual representation as LATIN SMALL LETTER E WITH ACUTE). Any person or application that is writing or interpreting data in the OWL XML Serialization must take care to use the IRI that matches the intended semantics, and avoid IRIs that may look similar. Further information about matching of similar characters can be found in Unicode Security Considerations [*UNISEC*] and Internationalized Resource Identifiers (IRIs) [*RFC3987*] Section 8.
Interoperability considerations
There are no known interoperability issues.
Published specification
This specification.
Applications which use this media type
None at current time.
Additional information
None.
Magic number(s)
OWL XML documents are XML documents and thus may have initial strings similar to any XML document.
File extension(s)

".owx"

Base URI
As in XML.

Macintosh file type code(s)
"TEXT"

Person & email address to contact for further information
Sandro Hawke <sandro@w3.org>

Intended usage
COMMON

Restrictions on usage
None

Author/Change controller
The OWL XML Serialization is the product of the W3C OWL Working Group; W3C reserves change control over this specification.

5 Acknowledgments

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We would also like to thank two past members of the working group: Jeremy Carroll, and Vipul Kashyap.

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