



*International
Virtual
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Alliance*

Model Instances in Votables Version 1.0

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Working group

DM

This version

<http://www.ivoa.net/documents/merged-syntax/20211012>

Latest version

<http://www.ivoa.net/documents/merged-syntax>

Previous versions

This is the first public release

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Abstract

Vodml-instance-vot proposes a syntax to map VOTable data on any model serialized in VO-DML. Vodml-instance-vot annotations are grouped in a single XML block located in the VOTable head. The annotation block allows to easily reconstruct the model structure. It is designed in a way that the block can be reused on different data sets in order to facilitate the annotation process. Vodml-instance-vot is enabled to join data from different tables

Status of this document

This is an IVOA Working Draft for review by IVOA members and other interested parties. It is a draft document and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use IVOA Working Drafts as reference materials or to cite them as other than “work in progress”.

A list of current IVOA Recommendations and other technical documents can be found at <http://www.ivoa.net/documents/>.

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Conformance-related definitions

The words “MUST”, “SHALL”, “SHOULD”, “MAY”, “RECOMMENDED”, and “OPTIONAL” (in upper or lower case) used in this document are to be interpreted as described in IETF standard RFC2119 (?).

The *Virtual Observatory (VO)* is a general term for a collection of federated resources that can be used to conduct astronomical research, education, and outreach. The [International Virtual Observatory Alliance \(IVOA\)](#) is a global collaboration of separately funded projects to develop standards and infrastructure that enable VO applications.

1 Introduction

1.1 Role within the VO Architecture

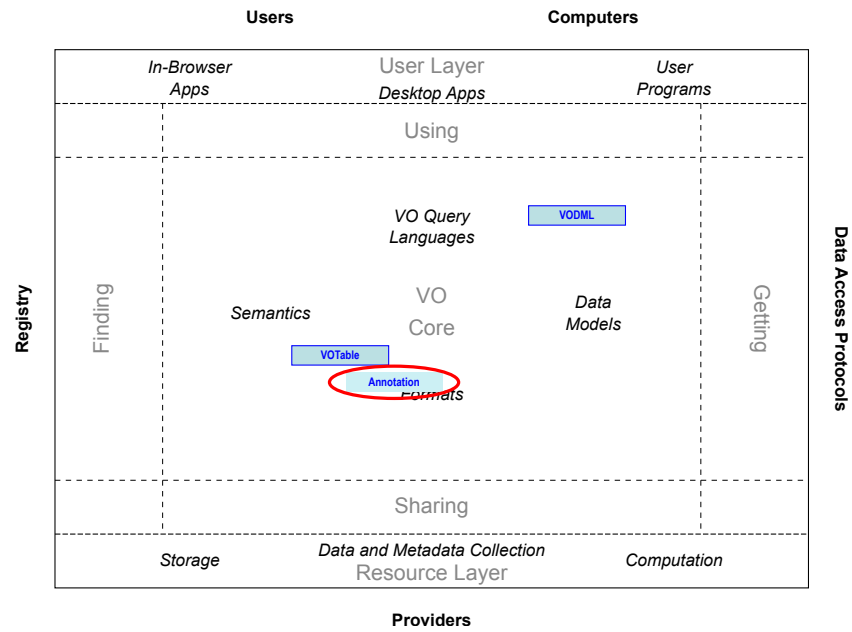


Figure 1: Architecture diagram for this document

Fig. 1 shows the role this document plays within the IVOA architecture (?).

2 Use Cases and Requirements

2.1 Use Cases

2.2 Requirements

3 Relation to VOTable

The data model annotation will reside within the scope of a VOTable. *Describe which version(s) of VOTable should this be expected to work with?* V1.3+

Location

The mapping block:

- MUST be contained in a VOTable RESOURCE with `type="meta"`.
- which MUST be the first child of a RESOURCE with `type="results"`.
- there MUST be no more than one mapping block per 'results' RESOURCE.

The scope of the mapping block is the whole content of the 'results' RESOURCE.

Namespace

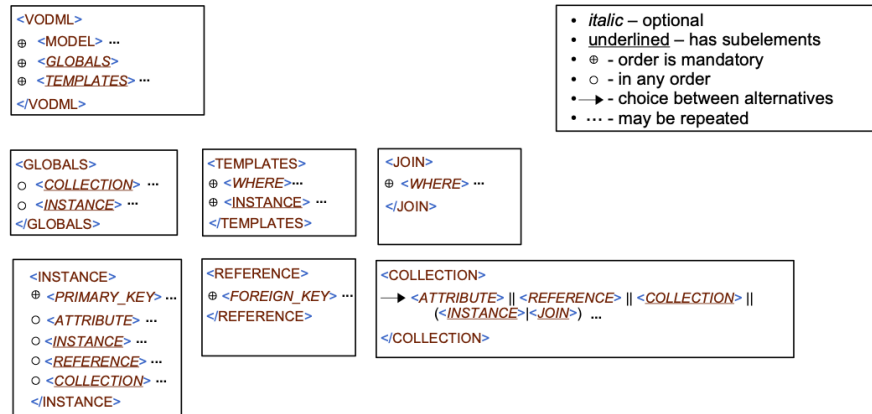
The `dm-mapping` name space isolates VOTable elements from mapping elements, and MUST be defined on the mapping block.

```
<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.3">
  <RESOURCE type="results">
    <RESOURCE type="meta">
      <dm-mapping:VODML xmlns:dm-mapping="http://www.ivoa.net/xml/merged-syntax">
        ...
      </dm-mapping:VODML>
    </RESOURCE>
    <TABLE name="myDataTable">
      ...
    </TABLE>
  </RESOURCE>
</VOTABLE>
```

Listing 1: Mapping block in a VOTable

4 Syntax

Element Hierarchy



4.1 VODML

The VODML element is the top level container for the mapping elements for a single VOTable RESOURCE.

```
<dm-mapping:VODML>
  <dm-mapping:MODEL> ... </dm-mapping:MODEL>
  <dm-mapping:GLOBALS> ... </dm-mapping:GLOBALS>
  <dm-mapping:TEMPLATES> ... </dm-mapping:TEMPLATES>
  ...
</dm-mapping:VODML>
```

Listing 2: Example VODML mapping block

Element	Position	Cardinality
MODEL	1	1-*
GLOBALS	2	0-*
TEMPLATES	3	0-*

Table 1: Allowed children for VODML

4.2 REPORT

In the case of services able to provide annotated responses, we need an element telling the client whether the annotation process succeed or not. This is the purpose of the **REPORT** element. **REPORT** is not mandatory. If present; it must be the first VODML child

```
<dm-mapping:VODML
  xmlns:dm-mapping="http://www.ivoa.net/xml/merged-syntax">

  <dm-mapping:REPORT status="KO">
    The annotation process failed
  </dm-mapping:REPORT>

  <dm-mapping:MODEL name="model" url="http://aaaaaa" />
  <dm-mapping:MODEL name="model" />

</dm-mapping:VODML>
```

Listing 3: Example of a REPORT element

Attribute	Role
@status	Status of the annotation process.; must be either OK or KO

Table 2: REPORT attributes

4.3 MODEL

A VOTable can provide serializations for an arbitrary number of data model types. In order to declare which models are represented in the file, data providers must declare them through the MODEL elements. Only models

that are used in the file must be declared. A model is used if at least one element in the mapping block refer to it. In other terms, only models that define vodml-ids used in the annotation must be declared.

```
<dm-mapping:VODML>
  <dm-mapping:MODEL name="sample-ext"
    url="https://www.myorg.net/models/SampleExt-v1.0.vo-dml.xml" />
  <dm-mapping:MODEL name="sample" url="https://www.ivoa.net/xml/DNE/Sample-v1.0.vo-dml.xml" />
  <dm-mapping:MODEL name="ivoa" url="https://www.ivoa.net/xml/VODML/IVOA-v1.vo-dml.xml" />
</dm-mapping:VODML>
```

Listing 4: Example MODEL mapping block

Attribute	Role
@name	Name of the mapped model as declared in the VODML/XML model serialization. This attribute MUST not be empty and forms the prefix used in dmrole/dmtype tags of elements from that model.
@url	URL to the vo-dml serialization of the model. If present, this attribute MUST not be empty.

Table 3: MODEL attributes

@name	@url	Pattern
MAND	OPT	Unique attribute pattern supported by MODEL

Table 4: Valid attribute patterns for MODEL

4.4 GLOBALS

The GLOBALS block holds singular data model instances, and is not associated with a VOTable TABLE.

The contained instances have a global scope, and may be referenced by other instances anywhere in the mapping block. INSTANCE attributes within the GLOBALS scope may only refer to VOTable PARAMS or contain explicit values, they MUST NOT refer to VOTable FIELDS. Note: This rule is not enforced via the XSD schema which is restricted to the mapping block only.

Related instances may be grouped within a COLLECTION block to enable selection via the ORM elements provided in this syntax. See COLLECTION for more details.

```
<dm-mapping:VODML>
  <dm-mapping:MODEL name="sample" url="https://www.ivoa.net/xml/DNE/Sample-v1.0.vo-dml.xml" />
  <dm-mapping:MODEL name="ivoa" url="https://www.ivoa.net/xml/VODML/IVOA-v1.vo-dml.xml" />
  <dm-mapping:GLOBALS>
    <!-- a collection of coordinate systems -->
    <dm-mapping:COLLECTION dmid="_CoordinateSystems" >
      <dm-mapping:INSTANCE dmid="_Timesys" dmtype="sample:TimeSys">
        ...
      </dm-mapping:INSTANCE>
      <dm-mapping:INSTANCE dmid="_Spacesys" dmtype="sample:SpaceSys">
        ...
      ...
    </dm-mapping:COLLECTION>
  </dm-mapping:GLOBALS>
</dm-mapping:VODML>
```

```

</dm-mapping:INSTANCE>
</dm-mapping:COLLECTION>

<!-- a singular, stand-alone instance -->
<dm-mapping:INSTANCE dmtype="sample:Thing">
  <dm-mapping:ATTRIBUTE dmrole="sample:Thing.name" dmtype="ivoa:string" value="MyThing"/>
  <dm-mapping:ATTRIBUTE dmrole="sample:Thing.date" dmtype="ivoa:string" ref="\_date"/>
  ...
</dm-mapping:INSTANCE>
</dm-mapping:GLOBALS>
</dm-mapping:VODML>

```

Listing 5: Example GLOBALS block

Element	Position	Cardinality
INSTANCE	Any	0-*
COLLECTION	Any	0-*

Table 5: Allowed children for GLOBALS

4.5 TEMPLATES

The **TEMPLATES** block defines a template for deriving multiple data model instances, one for each row of the associated VOTable **TABLE**. A subset of the associated **TABLE** rows may be selected using the **WHERE** syntax element.

```

<dm-mapping:VODML>
  <dm-mapping:MODEL name="sample" url="https://www.ivoa.net/xml/DNE/Sample-v1.0.vo-dml.xml" />
  <dm-mapping:MODEL name="ivoa" url="https://www.ivoa.net/xml/VODML/IVOA-v1.vo-dml.xml" />
  <dm-mapping:TEMPLATES tableref="Results">
    <!-- instance template -->
    <dm-mapping:INSTANCE dmtype="sample:Thing">
      <dm-mapping:ATTRIBUTE dmrole="sample:Thing.name" dmtype="ivoa:string" ref="\_field1"/>
      <dm-mapping:ATTRIBUTE dmrole="sample:Thing.date" dmtype="ivoa:string" ref="\_field2"/>
      ...
    </dm-mapping:INSTANCE>
  </dm-mapping:TEMPLATES>
</dm-mapping:VODML>

```

Listing 6: Example TEMPLATES block

Attribute	Role
@tableref	ID of the mapped VOTable TABLE .

Table 6: TEMPLATES attributes

@tableref	Pattern
OPT	If @tableref is not present, TEMPLATES maps the first TABLE of the RESOURCE

Table 7: Valid attribute patterns for TEMPLATES

Element	Position	Cardinality	
WHERE	1	0-*	The mapping applies to rows matching the WHERE condition only
INSTANCE	2	0-*	Mapped instance templates

Table 8: Allowed children for TEMPLATES

4.6 COLLECTION

COLLECTION is a container element. It is used in different contexts, each allowing a limited subset of elements for its content.

1. As child of INSTANCE

The COLLECTION serves as a container for elements with multiplicity > 1.

Examples of usage in this context would be:

- an array attribute
- a reference relation with multiplicity > 1
- a composition relation with multiplicity > 1

2. As child of GLOBALS

The COLLECTION serves as a proxy for TABLE, grouping common INSTANCES for selection by PRIMARY/FOREIGN_KEY. Examples of usage in this context would be:

- a set of photometry filters, which apply to various rows of a photometric data table, based on the value of the 'band' column.
- a set of Dataset metadata instances, which apply to various rows of a photometric data table, based on the value of the 'band' column.

3. As child of COLLECTION

The use-case for this is unclear

```
<dm-mapping:INSTANCE dmtpe="model:Thing">
  <dm-mapping:COLLECTION dmrole="model:Thing elems">
    <dm-mapping:ATTRIBUTE dmtpe="model:Foo" value="100" />
    <dm-mapping:ATTRIBUTE dmtpe="model:Foo" value="110" />
  </dm-mapping:COLLECTION>
</dm-mapping:INSTANCE>
```

Listing 7: Example of COLLECTION child of INSTANCE

```

<dm-mapping:GLOBALS>
  <dm-mapping:COLLECTION dmid=" filters" >
    <dm-mapping:INSTANCE dmtype="model:PhotometryFilter" >
      <dm-mapping:PRIMARY_KEY dmtype="ivoa:string" value="RP"/>
      <dm-mapping:ATTRIBUTE dmrole="model:PhotometryFilter.name" dmtype="ivoa:string"
        value="GAIA/GAIA2r.Grp"/>
    </dm-mapping:INSTANCE>
    <dm-mapping:INSTANCE dmtype="model:PhotometryFilter" >
      <dm-mapping:PRIMARY_KEY dmtype="ivoa:string" value="BP"/>
      <dm-mapping:ATTRIBUTE dmrole="model:PhotometryFilter.name" dmtype="ivoa:string"
        value="GAIA/GAIA2r.Gbp"/>
    </dm-mapping:INSTANCE>
  </dm-mapping:COLLECTION>
</dm-mapping:GLOBALS>

```

Listing 8: Example of COLLECTION child of GLOBALS

Attribute	Role
@dmid	Element dmid, MUST be unique within the document.
@dmrole	Role of the COLLECTION in the data model.

Table 9: COLLECTION attributes

Context	@ID	@dmrole	Pattern
1	OPT	MAND	The element maps a collection playing a role in a modeled INSTANCE. @dmrole MUST not be empty. If present, @dmid MUST not be empty.
2	MAND	NO	The collection, has no role. MUST have non-empty dmid to reference for ORM selection of contained INSTANCE.

Table 10: Valid attribute patterns for COLLECTION

Context: Child of INSTANCE			
Element	Position	Cardinality	
ATTRIBUTE	Only	0-*	Collection of attributes.
REFERENCE	Only	0-*	Collection of references.
INSTANCE and/or JOIN	Any	0-*	Collection of instances.
COLLECTION	Only	0-*	Collection of collections.
Context: Child of GLOBALS			
Element	Position	Cardinality	
INSTANCE	Only	0-*	Collection of related instances.

Table 11: Allowed children for COLLECTION

4.7 INSTANCE

Mark proposal (as interpreted by LM)

The INSTANCE element defines a complex ObjectType or DataType.

```
<dm-mapping:INSTANCE dmid="SpaceFrame_ICRS" dmtype="coords:SpaceFrame">
  <dm-mapping:INSTANCE dmrole="coords:SpaceFrame.refPosition"
    dmtype="coords:StdRefLocation">
    <dm-mapping:ATTRIBUTE dmrole="coords:StdRefLocation.position"
      dmtype="ivoa:string" value="NoSet" />
  </dm-mapping:INSTANCE>
  <dm-mapping:ATTRIBUTE dmrole="coords:SpaceFrame.spaceRefFrame"
    dmtype="ivoa:string" value="ICRS" />
  <dm-mapping:ATTRIBUTE dmrole="coords:SpaceFrame.equinox"
    dmtype="coords:Epoch" value="2015" />
</dm-mapping:INSTANCE>
```

Listing 9: Example of INSTANCE child of GLOBALS

Attribute	Role
@dmid	Element dmid, MUST be unique within the mapping block
@dmrole	INSTANCE role in the DM
@dmtype	Class name

Table 12: INSTANCE attributes

It may be a child of several other elements, and the requirements on the content (especially dmid and dmrole), may differ depending on the usage:

- Child of GLOBALS: In this case the INSTANCE is a single stand-alone instance which may or may not be referenced by other INSTANCES.
 - must have dmid, as possible target of REFERENCE.ref
 - must have no or empty dmrole
- Child of TEMPLATES: In this case, the INSTANCE is a template for instances which are generated once per row of the associated table.
 - may have dmid, as target of JOIN.dmref
 - must have no or empty dmrole
- Child of COLLECTION: There are 2 uses for this pattern.
 - each member INSTANCE is a target for selection using the PRIMARY/FOREIGN_KEY elements. This pattern is only allowed within the GLOBALS environment. In this case:
 - * must contain at least one PRIMARY_KEY sub-element
 - * must have dmid, as possible target of REFERENCE.ref
 - * must have no or empty dmrole
 - Elements INSTANCE are collection cells with multiplicity > 1
Each one has:

- * must have dmid, as possible target of REFERENCE.ref. this pattern is only allowed if within the GLOBALS environment
- * must have no or empty dmrole
- Child of INSTANCE: In this case, each INSTANCE represents a complex ObjectType or DataType playing a role in the parent INSTANCE.
 - * must not have dmid (may not be referenced) ??
 - * must have non-empty dmrole
- any INSTANCE:
 - * if dmid is present, it must not be empty
 - * must have non-empty dmtype

Element	Position	Cardinality	
PRIMARY_KEY	First	0-*	Primary key to be used to in a JOIN context.
REFERENCE	Any	0-*	Object attribute as a reference to either another INSTANCE or a COLLECTION.
INSTANCE	Any	0-*	Object attribute as a class instance.
ATTRIBUTE	Any	0-*	Object attribute as a simple attribute.
COLLECTION	Any	0-*	Object attribute as a collection.

Table 13: Allowed children for INSTANCE

Original

VO-DML structured types are annotated by using the `INSTANCE` element. Note that there is no difference, from a schema point of view, between `ObjectType` and `DataType`.

```
<dm-mapping:INSTANCE dmid="SpaceFrame_ICRS" dmtype="coords:SpaceFrame">
  <dm-mapping:INSTANCE dmrole="coords:SpaceFrame.refPosition"
    dmtype="coords:StdRefLocation">
    <dm-mapping:ATTRIBUTE dmrole="coords:StdRefLocation.position"
      dmtype="ivoa:string" value="NoSet" />
  </dm-mapping:INSTANCE>
  <dm-mapping:ATTRIBUTE dmrole="coords:SpaceFrame.spaceRefFrame"
    dmtype="ivoa:string" value="ICRS" />
  <dm-mapping:ATTRIBUTE dmrole="coords:SpaceFrame.equinox"
    dmtype="coords:Epoch" value="2015" />
</dm-mapping:INSTANCE>
```

Listing 10: INSTANCE child of GLOBALS

Attribute	Role
@dmid	Element dmid, MUST be unique within the mapping block
@dmrole	INSTANCE role in the DM
@dmtype	Class name

Table 14: INSTANCE attributes

@dmid	@dmrole	@dmtype	Pattern
MAND	NO or EMPTY	MAND	MUST be applied when the <code>INSTANCE</code> is child of <code>GLOBALS</code> . The element has no role because it is not embedded in a model mapping block. It must be referable by a <code>REFERENCE</code>
OPT	MAND	MAND	MUST be applied in any other location. It may be referable a <code>REFERENCE</code> .

Table 15: Valid attribute patterns for INSTANCE

Element	Position	Cardinality	
PRIMARY_KEY	First	0-*	Primary key to be used to in a JOIN context.
REFERENCE	Any	0-*	Object attribute as a reference to either another INSTANCE or a COLLECTION.
INSTANCE	Any	0-*	Object attribute as a class instance.
ATTRIBUTE	Any	0-*	Object attribute as a simple attribute.
COLLECTION	Any	0-*	Object attribute as a collection.

Table 16: Allowed children for INSTANCE

4.8 ATTRIBUTE

Attribute	Role
@dmrole	Role of the attribute in the DM
@dmtype	Type of the attribute in the DM
@ref	Reference of the FIELD or PARAM that has to be sued to set the ATTRIBUTE value.
@value	Default ATTRIBUTE value. This value is taken if there is no @ref attribue or if @ref cannot be resolved.
@unit	ATTRIBUTE unit. This is the unit in which the native value must be converted to be compliant with the model. This attribute is always optional.
@arrayindex	Index of the native value to be taken to set the ATTRIBUTE. Must be ignored if the native value is a single value. An error must be risen if @arrayindex is out of range.This attribute is always optional.

Table 17: ATTRIBUTE attributes

@dmrole	@dmtype	@ref	@value	Pattern
MAND	MAND	MAND	OPT	The ATTRIBUTE value must be set with the value of the element referenced by @ref. The @ref can not be resolved and @value is present, @value must taken as ATTRIBUTE value
MAND	MAND	NO	MAND	The ATTRIBUTE value must be set with @value

Table 18: Valid attribute patterns for ATTRIBUTE

4.9 REFERENCE

Complex pattern that must be detailed later in a specific section

Attribute	Role
@dmrole	Role of the referenced instance or collection in the DM
@tableref	dmid of the COLLECTION to be joined with in case of using a FOREIGN_KEY
@dmref	dmid of the referenced instance or collection

Table 19: REFERENCE attributes

@dmrole	@tableref	@dmref	Pattern
MAND	MAND	NO	This is the FOREIGN_KEY pattern. @tableref gives the dmid of the COLLECTION to be joined with. In this case REFERENCE must have one FOREIGN_KEY child and the joined COLLECTION must have a PRIMARY_KEY
MAND	NO	MAND	Simple reference to either an INSTANCE or COLLECTION, usually searched in the GLOBALS

Table 20: Valid attribute patterns for REFERENCE

4.10 JOIN

Attribute	Role
@tableref	Reference of the table to be joined with.
@dmref	Reference of the COLLECTION (in GLOBALS to be joined with.

Table 21: JOIN attributes

@tableref	@dmref	Pattern
MAND	NO	The join is done against the table identified by @tableref
NO	MAND	The join is done against the COLLECTION identified by @dmref

Table 22: Valid attribute patterns for JOIN

Element	Position	Cardinality	
WHERE	1	0-*	Join condition

Table 23: Allowed children for JOIN

4.11 WHERE

Attribute	Role
@primarykey	FIELD identifier of the primary key column
@foreignkey	FIELD identifier of the foreign key column
@value	Literal value the @primarykey cell must match with

Table 24: WHERE attributes

@primarykey	@foreignkey	@value	Pattern
MAND	MAND	NO	2 tables join criteria: @primarykey = @foreignkey
MAND	NO	MAND	Simple join criteria: @primarykey = @value

Table 25: Valid attribute patterns for WHERE

4.12 PRIMARY_KEY

Attribute	Role
@ref	ID of the FIELD used as primary key
@dmtype	Type of the key
@value	Literal key value. Used when the key relates to a COLLECTION in the GLOBALS

Table 26: PRIMARY_KEY attributes

@ref	@dmtype	@value	Pattern
MAND	MAND	NO	The FIELD referenced by @ref is a primary key. This pattern is used within a TEMPLATES
NO	MAND	MAND	@value gives the key value. This pattern is used to set a primary key to a COLLECTION

Table 27: Valid attribute patterns for PRIMARY_KEY

4.13 FOREIGN_KEY

Attribute	Role
@ref	Only used in REFERENCE. Identifier of the FIELD that must match the primary key of the referenced collection

Table 28: FOREIGN_KEY attributes

5 Changes from Previous Versions

No previous versions yet.