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Observatory
Alliance

Model Instances in Votables
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Working group
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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 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 enable 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/.

Contents

Acknowledgments

CDS/TDIG/SourceDM contributors

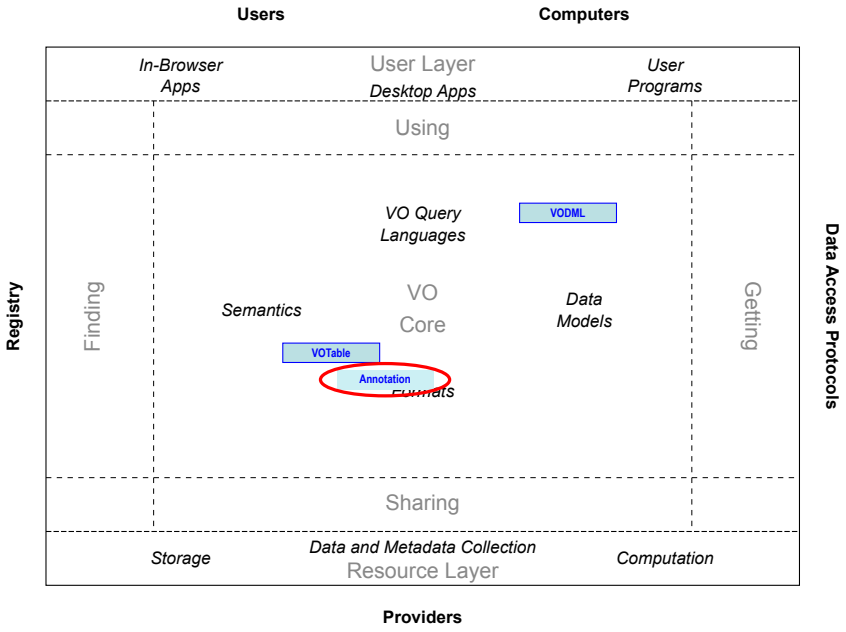


Figure 1: Architecture diagram for this document

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 (Bradner, 1997).

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

Fig. 1 shows the role this document plays within the IVOA architecture (Arviset and Gaudet et al., 2010).

???? and so on, LaTeX as you know and love it. ????

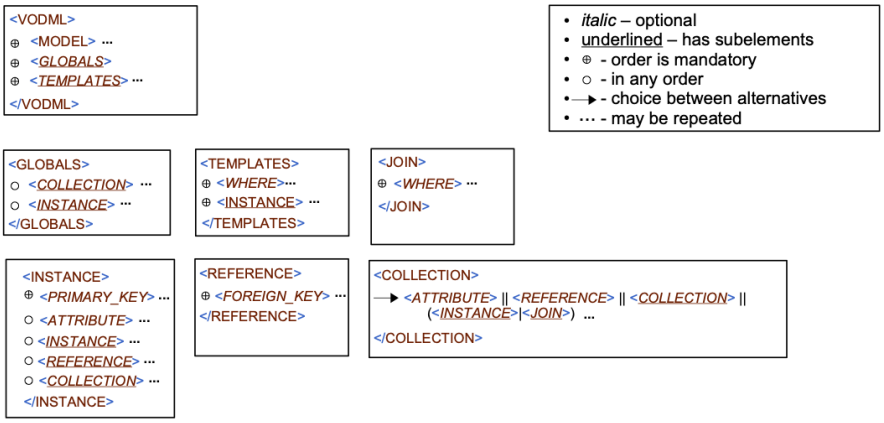
2 Use Cases and Requirements

2.1 Use Cases

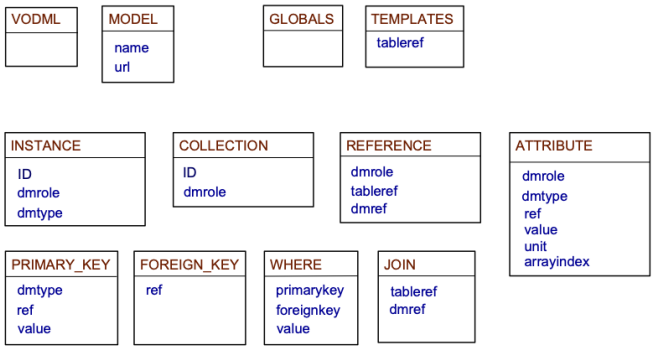
2.2 Requirements

3 Syntax

Element Hierarchy



Attribute Summary



3.1 Mapping Block Scope

The mapping block must be isolated in a VOTable RESOURCE with `type="meta"`. This RESOURCE must be the first child of a RESOURCE `type="results"`. The scope of the mapping block is the whole content of that resource.

The `dm-mapping` name space isolate VOTable elements from mapping elements.

A VOTable RESOURCE type="results" must contain at most one 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:MODEL> ... <dm-mapping:/MODEL>
        <dm-mapping:MODEL> ... <dm-mapping:/MODEL>
        ...
        <dm-mapping:GLOBALS> ... </dm-mapping:GLOBALS>
        <dm-mapping:TEMPLATES> ... </dm-mapping:TEMPLATES>
        <dm-mapping:TEMPLATES> ... </dm-mapping:TEMPLATES>
        ...
      </dm-mapping:VODML>
    </RESOURCE>
    <RESOURCE type="results">
      <TABLE name="Results">
      ....
      </TABLE>
    </RESOURCE>
  </RESOURCE>
</VOTABLE>
```

Listing 1: Mapping block in a VOTable

3.2 Mapping Block Structure

```
<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: Complete mapping block example

3.3 Syntax

3.3.1 VODML

Top level mapping element.

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

Table 1: Allowed children for VODLM

3.3.2 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.

Attribute	Role
@name	Name of the mapped model (informal). This attribute cannot be left empty
@url	Url of the vo-dml serialization of the model. This attribute cannot be left empty if present.

Table 2: MODEL attributes

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

Table 3: Valid attribute patterns for MODEL

3.3.3 GLOBALS

Some annotations may map the Resource contents to instances or collections of data model types that are global in the mapping scope, possibly because such instances are refer- enced by other intances that annotate specific tables. More generally, some annotations will define instances that are completely defined in terms of constant value, i.e. they are not represented in tabular form. Rather, they are completely and directly represented by an XML element. Such instances should be included in the GLOBALS element. GLOBALS must only contain direct representations of instances, i.e. INSTANCE elements that do not refer to any FIELD directly. This rule is not enforces via the XSD schema Also, GLOBALS should not contain any INSTANCEs with REFERENCEs to indirect INSTANCEs.

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

Table 4: Allowed children for GLOBALS

3.3.4 TEMPLATES

Attribute	Role
@tableref	ID of the mapped table.

Table 5: TEMPLATES attributes

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

Table 6: Valid attribute patterns for TEMPLATES

Element	Position	Cardinality	
WHERE	1	0-*	The mapping must be applied to the rows matching the WHERE condition only
INSTANCE	2	0-*	Mapped class instances

Table 7: Allowed children for TEMPLATES

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

Listing 3: Example of COLLECTION child of INSTANCE

```
<dm-mapping:GLOBALS>
    <dm-mapping:COLLECTION ID="_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 4: Example of COLLECTION child of GLOBALS

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

Table 8: `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, @ID MUST not be empty.
2	MAND	NO	The collection, has no role. MUST have non-empty ID to reference for ORM selection of contained `INSTANCE`.

Table 9: 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 10: Allowed children for `COLLECTION`

3.3.6 INSTANCE

Mark proposal (as interpreted by LM

The INSTANCE element defines a complex ObjectType or DataType.

```
<dm-mapping:INSTANCE ID="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 5: Example of INSTANCE child of GLOBALS

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

Table 11: `INSTANCE` attributes

It may be a child of several other elements, and the requirements on the content (especially ID 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 ID, 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 ID, as target of JOIN.dmref
  - must have no or empty dmrole `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 ID, 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 ID, 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 ID (may not be referenced) ??
    - must have non-empty dmrole
  - any INSTANCE:
    - if ID 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 12: 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 ObjectTypes and DataType.

```
<dm-mapping:INSTANCE ID="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 6: INSTANCE child of GLOBALS

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

Table 13: INSTANCE attributes

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

Table 14: 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 15: Allowed children for INSTANCE

3.3.7 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 complient 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 16: 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 17: Valid attribute patterns for `ATTRIBUTE`

3.3.8 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	ID of the `COLLECTION` to be joined with in case of using a `FOREIGN_KEY`
@dmref	ID of the referenced instance or collection

Table 18: `REFERENCE` attributes

@dmrole	@tableref	@dmref	Pattern
MAND	MAND	NO	This is the `FOREIGN_KEY` pattern. @tableref gives the ID 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 19: Valid attribute patterns for `REFERENCE`

3.3.9 JOIN

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

Table 20: `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 @rmref

Table 21: Valid attribute patterns for `JOIN`

Element	Position	Cardinality	
`WHERE`	1	0-*	Join condition

Table 22: Allowed children for `JOIN`

3.3.10 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 23: `WHERE` attributes

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

Table 24: Valid attribute patterns for `WHERE`

3.3.11 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 25: `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 26: Valid attribute patterns for `PRIMARY_KEY`

3.3.12 FOREIGN_KEY

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

Table 27: `FOREIGN_KEY` attributes

4 Changes from Previous Versions

No previous versions yet.

References

Arviset, C., Gaudet, S. and the IVOA Technical Coordination Group (2010), 'IVOA architecture', IVOA Note.
http://www.ivoa.net/documents/Notes/IVOAArchitecture

Bradner, S. (1997), 'Key words for use in RFCs to indicate requirement levels', RFC 2119.
http://www.ietf.org/rfc/rfc2119.txt