



Model Instances in Votables

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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 able 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

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

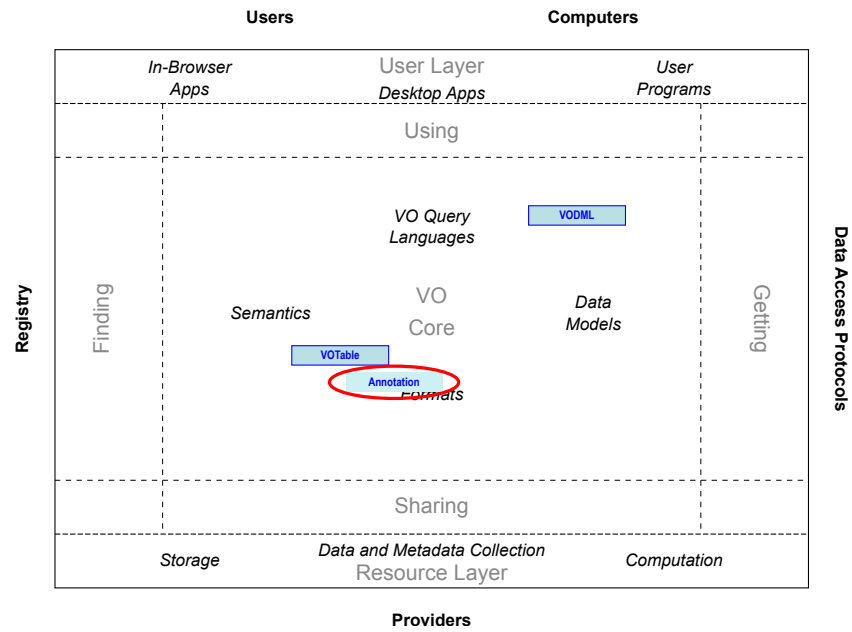


Figure 1: Architecture diagram for this document

Fig. ?? 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

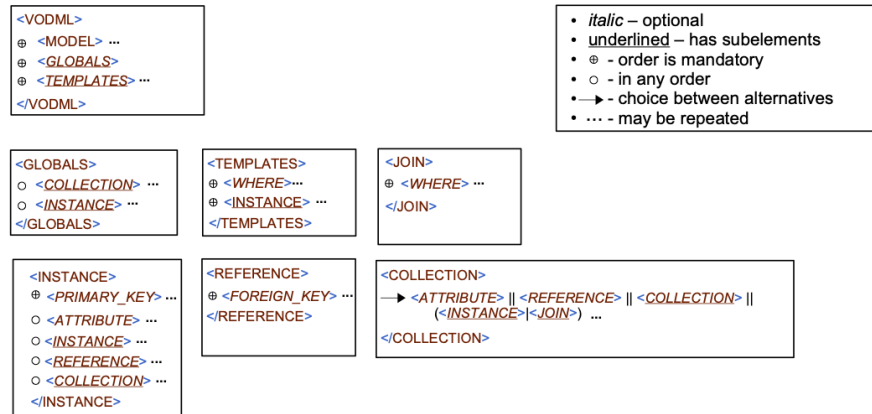
The `dm-mapping` name space isolates VOTable elements from mapping elements, and MUST be defined on the mapping block.

```
<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 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 3: 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 2: MODEL attributes

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

Table 3: Valid attribute patterns for MODEL

4.3 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" dmtpe="sample:TimeSys">
        ...
      </dm-mapping:INSTANCE>
      <dm-mapping:INSTANCE dmid="\_spacesys" dmtpe="sample:SpaceSys">
        ...
      </dm-mapping:INSTANCE>
    </dm-mapping:COLLECTION>

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

Listing 4: Example GLOBALS block

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

Table 4: Allowed children for GLOBALS

4.4 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 dmtpe="sample:Thing">
      <dm-mapping:ATTRIBUTE dmrole="sample:Thing.name" dmtpe="ivoa:string" ref="\_field1"/>
      <dm-mapping:ATTRIBUTE dmrole="sample:Thing.date" dmtpe="ivoa:string" ref="\_field2"/>
      ...
    </dm-mapping:INSTANCE>
  </dm-mapping:TEMPLATES>
</dm-mapping:VODML>

```

Listing 5: Example TEMPLATES block

Attribute	Role
@tableref	ID of the mapped VOTable 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 applies to rows matching the WHERE condition only
INSTANCE	2	0-*	Mapped instance templates

Table 7: Allowed children for TEMPLATES

4.5 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 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 6: Example of COLLECTION child of INSTANCE

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

Listing 7: 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 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, @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 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**

4.6 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 8: 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 11: **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` `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 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 **ObjectType** and **DataType**.

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

Listing 9: INSTANCE child of GLOBALS

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

Table 13: INSTANCE attributes

@dmid	@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**

4.7 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 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 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**

4.8 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	dmid of the COLLECTION to be joined with in case of using a FOREIGN_KEY
@dmref	dmid 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 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 19: Valid attribute patterns for **REFERENCE**

4.9 JOIN

The **JOIN** element allows to populate a **COLLECTION** with **INSTANCES** from another collection, namely the foreign collection. The foreign collection can either be a static element (**GLOBALS/COLLECTION**) or a collection of **INSTANCES** resulting from the iteration over a **TEMPLATES**.

The JOIN element must contain attributes identifying the foreign collection (@tableref and/or @dmref). It can have WHERE children stating the join condition.

It must be child of a COLLECTION that has not other children element that INSTANCE. A COLLECTION cannot host more that 1 JOIN.

JOIN may have 2 uses:

- Join with TEMPLATES data:
 - must have a @tableref attribute identifying the foreign TEMPLATES
 - may have a @dmref attribute the identify an INSTANCE within the foreign TEMPLATES.

The mapping of the enclosing COLLECTION items can be either implicit or explicit:

- If it has no other children, it must be populated with the whole table rows.
- Otherwise the item content is given by the enclosed INSTANCE. The reference (@ref) contained in those INSTANCES must refer to te field of the foreign table.

- Join with COLLECTION data:
 - must have no @tableref attribute, referencing a table in this case is irrelevant.
 - must have a @dmref attribute the identify the COLLECTION to be joined with. This COLLECTION must be GLOBALS child.

The mapping of the enclosing COLLECTION items can be either implicit or explicit:

- If it has no other children, it must be populated with the foreign collection items.
- Otherwise the item content is given by the enclosed INSTANCES. The reference (@ref) contained in those INSTANCES must refer to te field of the foreign table, we must not have such @ref if the foreign collection is static

The mapping of items of te COLLECTION enclosing the JOIN can be either implicit or explicit:

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 @dmref

Table 21: Valid attribute patterns for JOIN

Element	Position	Cardinality	
WHERE	1	0-*	Join condition

Table 22: Allowed children for JOIN

4.10 WHERE

The WHERE element is used to filter iteration outputs. Value are accepted when the key equals to the value. The mapping syntax does not specify the data types to be used to evaluate the expression. There are 2 different uses for this element:

- As a child of **TEMPLATES**. Only the table rows satisfying the WHERE conditions will be mapped. With this pattern WHERE must have one @primarykey attribute and one @value attribute. @primarykey references the column (**FIELD**) to be checked. The WHERE condition is satisfied for the rows having @primarykey equals to @value
- As a child of **JOIN**. Only the joined data items satisfying the WHERE conditions will be taken. With this pattern WHERE must have one @foreignkey attribute and one @value or @primarykey attribute. @foreignkey references the column of the foreign collection to be checked. The WHERE condition is satisfied for the rows having @primarykey equals to @value or to the @primarykey value

```
<dm-mapping:TEMPLATES tableref="table">
  <dm-mapping:WHERE primarykey="col1" value="val1" />
  <dm-mapping:WHERE primarykey="col2" value="val2" />
  <dm-mapping:INSTANCE dmtype="type" />
</dm-mapping:TEMPLATES>
```

Listing 10: **WHERE** Example; Only rows having val1 as col1 value and val2 as col2 value are mapped

```
<dm-mapping:JOIN tabref="ft" >
  <dm-mapping:WHERE foreignkey="ftc" primarykey="ptc" />
</dm-mapping:JOIN>
```

Listing 11: WHERE Example; The join is satisfied when the value of the ptc column is equals to the ftc column of the foreign table

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

4.11 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

4.12 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

5 Changes from Previous Versions

No previous versions yet.