MapleMBSE Virtual Features Guide
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Preface

MapleMBSE Overview

MapleMBSE™ gives an intuitive, spreadsheet based user interface for entering detailed system design definitions, which include structures, behaviors, requirements, and parametric constraints.

Related Products

MapleMBSE 2019 requires the following products.

- Oracle® Java® SE Runtime Environment 8.

Note: MapleMBSE looks for a Java Runtime Environment in the following order:

1) If you use the -vm option specified in OSGiBridge.init (not specified by default), MapleMBSE will use it.

2) If your environment has a system JRE (meaning either: JREs specified by the environment variables JRE_HOME and JAVA_HOME in this order, or a JRE specified by the Windows Registry (created by JRE installer)), MapleMBSE will use it.

3) The JRE installed in the MapleMBSE installation directory.

If you are using IBM® Rational® Rhapsody® with MapleMBSE, the following versions are supported:

- Rational Rhapsody Version 8.1.5
- Teamwork Cloud™ server 18.5 SP3 or 19.0 SP2

Note that the architecture of the supported non-server products (that is, 32-bit or 64-bit) must match the architecture of your MapleMBSE architecture.
Related Resources

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<tr>
<td>MapleMBSE User Guide</td>
<td>Instructions for using MapleMBSE software. The <strong>MapleMBSE User Guide</strong> is available in the folder where you installed MapleMBSE.</td>
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For additional resources, visit [http://www.maplesoft.com/site_resources](http://www.maplesoft.com/site_resources).

**Getting Help**

To request customer support or technical support, visit [http://www.maplesoft.com/support](http://www.maplesoft.com/support).

**Customer Feedback**

Maplesoft welcomes your feedback. For comments related to the MapleMBSE product documentation, contact doc@maplesoft.com.
1 Introduction

1.1 Scope and Purpose of this Document

The purpose of the MapleMBSE Virtual Features Guide is to describe MapleMBSE virtual features and explain how to use them.

The intended audience for this document are users who are familiar with UML, SysML and Model-based Systems Engineering concepts and who intend to create their own MapleMBSE configuration files.

1.2 Pre requisite Knowledge

To fully understand the information presented in this document the reader should be familiar with the following concepts:

• The Eclipse Modeling Framework ecore serialization. In particular, knowing how to use any tool of your choice to track all the eReferences independently of the eSuperTypes.

• Thus, some basic concepts of Meta Object Facilty like eClassifiers and eStructuralFeatures. A correct mse configuration file has within each qualifier a concrete UML eClassifiers and each dimension should be accessed using a non-derived StructuralFeature defined in the UML.ecore or a virtual one inside this guide.

• MapleMBSE Configuration Language elements, (especially dimension and qualifiers, and the syntax for importing the MapleMBSE ecore). For more information on the MapleMBSE Configuration language, see the MapleMBSE Configuration Guide.

1.3 Motivation for Using MapleMBSE Virtual Features

SysML provides a high level of abstraction to cover as many modeling scenarios as possible with the diagrams offered. It is a powerful and complex language that is extremely difficult to master because of its complexity (there are hundreds of pages of technical specifications for SysML).

Many different concrete and abstract Classifiers, with very specific semantics, are part of the SysML technical specifications. These Classifiers should not be used interchangeably. Even "linking" elements changes depending on the "linked" elements. For example, SysML Associations are to Classes as Connectors are to Ports, or, what ControlFlows can be for ActivityNodes. However, these elements are not interchangeable.

An end user, defined as a user who will be updating model information using the MapleMBSE spreadsheet interface but likely will not be involved in creating or editing configuration files, who interested in taking advantage of the modeling capabilities of SysML, should not need to know its complexities. MapleMBSE helps to hide this complexity.
from the end user, through virtual features. They are called virtual features because, although they extend the capabilities of native SysML, they themselves are not part of SysML.

With the right choice of labels within an Excel template and a well designed configuration (.mse) file that implements MapleMBSE virtual features, an end user can enter a couple of inputs in a spreadsheet and create Blocks and the Associations linking them, or Ports and Connectors, or other combinations of elements.

For example, consider the following code snippet from a MapleMBSE configuration file in the figure below. This figure illustrates the scenario where a configuration file is designed without the use of virtual features to represent SysML Associations between Blocks.

Notice in the generated Excel worksheet, the number of inputs required of the end user to represent the Association between Customer and Product. This requires knowledge of SysML on the part of the end user.

Now consider an example that represents the same Association between Customer and Product, as shown in the figure below. This time, the configuration file is designed using the MapleMBSE virtual features, specifically, the associatedProperty virtual feature. Notice, the only inputs required of the end user are the two SysML Blocks, Customer and Product. The cross-references need for the Association are completed automatically.
1.4 Importing the MapleMBSE Ecore

Loading MapleMBSE virtual features is analogous to the way you would load UML Structural Features using UML Ecore. The corresponding MapleMBSE Configuration language uses `import-ecore`.

The general syntax is

```
import-ecore "URI"
```

For example, to specify the NoMagic ecore:

"http://www.nomagic.com/magicdraw/UML/2.5"

To specify the MapleMBSE ecore:

"http://maplembse.maplesoft.com/common/1.0"

You must create an alias for the ecore using the syntax:

```
import-ecore "URI" as Alias
```

For example, to specify an alias for the MapleMBSE ecore:

```
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse
```

This allows you to use the short form, `mse`, instead of the whole syntax.

1.5 General Syntax for the MapleMBSE Virtual Features

The general syntax for the virtual features is

```
[.//]alias::virtualfeature
```
The first character can be a dot, a forward slash, or a blank. There is no strict rule of thumb for this. For specific syntax, see the Syntax subsection for each virtual feature.

**alias** - This is the alias for the ecore import

**virtualfeature** - This is the virtual feature name you want to use, for example, associatedProperty.

### 1.6 List of Virtual Features

The MapleMBSE virtual features can be grouped into five categories:

**Stereotypes (page 5).** This group includes the `metaclassName` and `featureName` virtual features.

**Associations (page 11)** This group includes the `associatedProperty`, `directAssociatedProperty`, and `otherAssociatedEnd` virtual features.

**Connectors (page 21)** This group includes the `connectedPropertyOrPort` and `otherConnectorEnd` virtual features.

**Dependencies (page 25)** This group includes the `clientDependencies` and `supplierDependencies` virtual features.

**Util (page 33)** This group includes the `multiplicityProperty` virtual feature.
2 Stereotypes

SysML can be explained as a subset of elements defined in the UML specifications plus some additional features not included in UML. One of these features is a Stereotype. Stereotypes are applied to those elements adding extra meaning or modeling semantics. MapleMBSE offers several virtual features to apply Stereotypes and navigate their extended modeling capacities.

2.1 metaclassName

Description

Use the metaclassName virtual feature to apply Stereotypes while creating elements using MapleMBSE. To use this virtual feature you need to identify the qualified name of the Stereotype that you want to apply and whether the element is compatible with that stereotype.

Syntax

Any Element of the Model can have a list of appliedStereotype but only certain Stereotypes should be applied to certain Element. This is one of the few virtual features that is used as a filter inside the qualifier and it does not require a dot or slash notation prior to the alias. The metaclassName virtual feature must be followed by an equals simbol and the qualified name of the Stereotype between quotation mark.

alias::metaclassName="qualified::name"

It is important to note that this qualified name is basically a path and the name that identifies uniquely each Stereotype, and each substring is concatenated with a double colon notation.

Using the metaclassName Virtual Feature

The following steps illustrate what you need to do to use AssociatedProperty virtual feature:

1. The MapleMBSE ecore is imported and its alias is mse.
2. Two data-sources are used for this example with metaclassName to filter Blocks and Requirements. Note: both of those SysML concept are UML Classes but with different Stereotypes.
3. Defining synctable-schemas, one for Blocks and another for Requirements. Note: To avoid problems with MapleMBSE it is a good practice to use the same qualifier and Stereotype filter in the data-source and the first dimension of the schema.
4. Complete the rest of the configuration as usual: worksheet-templates, synctable and workbook.
Example

The following example showcases how to use `metaclassName` to create `Classes` applying 2 different `Stereotypes`.

```java
import.ecore "http://www.omg.com/magicdraw/UML/2.5"
import.ecore "http://maplembe.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source blocks = Root/packageElement[Class | mse:metaclassName="SysML::Blocks::Block"]
data-source requirements = Root/packageElement[Class | mse:metaclassName="SysML::Requirements::Requirement"]

symtable-schema BlockSchema {
    record din [Class | mse:metaclassName="SysML::Blocks::Block"] {
        key column /name as bname
    }
}

symtable-schema RequirementSchema {
    record din [Class | mse:metaclassName="SysML::Requirements::Requirement"] {
        key column /name as rname
    }
}

worksheet-template BlockTemplate (bsc: BlockSchema) {
    vertical table table at (1, 1) = bsc {
        key field bName: String
    }
}

worksheet-template RequirementTemplate(rsc: RequirementSchema) {
    vertical table table at (1, 1) = rsc {
        key field rName: String
    }
}
symtable blockTable = BlockSchema(blocks)
symtable requirementTable = RequirementSchema(requirements)

workbook {
    worksheet BlockTemplate(blockTable)
    worksheet RequirementTemplate(requirementTable)
}
```

Figure 2.1: `metaclassName` Example

2.2 `featureName`

Description

As mentioned in the introduction of this section, once you applied a `Stereotype` to any `Element`, you are changing its semantics and extending it. Use `featureName` to access those extended properties stored in `Slots` using their qualified names.

The class diagram in Figure 2.2 (page 7) shows the different `EClasses` that need to be queried in order to access those `Slots`, remember that `Element` is an abstract `EClass` and it should not be used as the qualifier. Basically all elements in a `Model` implement `Element`, thus `EClasses` like `Class` have the structural feature `appliedStereotypeInstance` to query `InstanceSpecification`.  

6 • 2 Stereotypes
Figure 2.2: A The appliedStereotypeInstance Structure

Syntax

Use `featureName` the same way `metaclassName` is used within a qualifier as a filter, meaning that no dot or slash notations are needed before the alias. It expected, following the virtual feature, an equal symbol and a string between quotation marks; this string is the qualified name of the property to access.

```
alias::featureName="qualified::name"
```

This qualified name is similar to the one used to identify the Stereotype but it differs slightly at the end with an extra information concatenated to identify a single extension. As mentioned before this virtual feature is usable while querying a Slot inside a InstanceSpecification inside an concrete Element, but you must also know that this Element must be filtered by `metaclassName` with the qualified name that identifies the Stereotype.

Using the featureName Virtual Feature

To access extra Properties added after applying a Stereotype:

1. Import the MapleMBSE ecore.
2. Inside a syntable-schema navigate to a MultiplicityElement, in this case, `/ownedAttribute[Property]` within a Class.
3. Within that dimension, define a regular column using `/mse::multiplicityProperty`.
4. Complete the rest of the configuration as usual: worksheet-templates, syntable and workbook.
Example

The following example illustrates how to access extra Properties added after applying a Stereotype.

1. Import MapleMBSE.ecore, for this example use mse as the alias.
2. Create a data-source using the metaclassName virtual feature mentioned before to filter Requirements.
3. Define a syntable-schema for Requirements. Note: use the same qualifier and Stereotype for the first dimension that for the data-source.
4. To access the SysML::Requirements::Requirement::Text Property added to a Class after applying the Requirement Stereotype you must:
   1. Navigate appliedStereotypeInstance to get an InstanceSpecification.
   2. Then slot to recover all the Slots within the InstanceSpecification
   3. Use featureName with the Slot qualifier to filter the Property that you want to access

Note: The qualified name of that Property is the name of the qualified Stereotype plus 2 colons and the name of the Property.

Stereotype: SysML::Requirements::Requirement
Property: SysML::Requirements::Requirement::Text

4. Complete the rest of the configuration as usual: worksheet-templates, syntable and workbook.

Figure 2.3: featureName Example
3 Associations

An Association between two Blocks creates cross references for two UML Classes with SysML Block Stereotypes (<<block>>) to one Association using two properties and also makes some cross references, like Type and Association, within those properties.

3.1 associatedProperty

Description

In MagicDraw, with a couple clicks from one block to another, all of these elements are correctly created. Similarly in MapleMBSE, the associatedProperty virtual feature provides the ability to connect two SysML Blocks, creating a bidirectional Association at the same hierarchical level in the diagram as the source Block.

When MapleMBSE queries the model, the associatedProperty returns the target Block (the Block that is related to a Property through an Association).

Syntax

The general syntax for using the associatedProperty virtual feature is as follows:

```
.alias::associatedProperty
```

Where alias is the alias you assigned to the MapleMBSE ecore. For more information on assigning aliases, see Importing the MapleMBSE Ecore (page 3).
The `associatedProperty` virtual feature must be used when querying the `Property` of a `Block`.

**Using the `associatedProperty` Virtual Feature**

The following example illustrates what you need to do to use `AssociatedProperty` virtual feature.

1. In line two, the `maplembse.ecore` is imported with an alias.
2. Use an `ownedAttribute[Property]` as the queried dimension.
3. Make a reference-query to a class using `mse::associatedProperty`.
Example

```java
import.ecore "http://www.nomagic.com/magicdraw/UML/2.5"
import.ecore "http://maplembse.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source structurePkg = Root/packageElement[Package]
data-source cls = structurePkg/packageElement[Class]

syncTable synctable-schema ClassTableSchema {
  dim [Class] {
    key column /name as ClassName
  }
}

syncTable synctable-schema ClassTreeTableSchema(blocks: ClassTableSchema) {
  record dim [Class] {
    key column /name as className1
  }
  dim /ownedAttribute[Property].mse::associatedProperty[Class] @ cls {
    reference-decomposition cls = cts {
      foreign-key column ClassName as referredClassName
    }
  }
}

synctable classTableSchema = ClassTableSchema<cls>
synctable classTreeTableSchema = ClassTreeTableSchema<cls>(classTableSchema)

worksheet-template ClassTable(cts: ClassTableSchema) {
  vertical table tbl at (6, 2) = cts {
    key field ClassName : String
    key field Name4 : String
  }
}

worksheet-template ClassTreeTable(ctt: ClassTreeTableSchema) {
  vertical table tbl at (6, 2) = ctt {
    key field ClassName1 : String
    key field referredClassName : String
  }
}

workbook{
  worksheet ClassTable(classTableSchema)
  worksheet ClassTreeTable(classTreeTableSchema)
}
```

Figure 3.1: associatedProperty Example
3.2 directedAssociatedProperty

Description

To create Associations with navigability in one direction MapleMBSE uses directedAssociatedProperty, using this virtual feature links two Classes and adds a Property to the source Block and other Property to an Association. Based on the aggregation value we can use this virtual feature to create Association, Aggregation and Composition with direction.

Syntax

The general syntax for using the directedAssociatedProperty virtual feature is as follows:

```
.alias::directedAssociatedProperty
```

Where alias is the alias you assigned to the MapleMBSE ecore (hyperlink to above).

The directedAssociatedProperty virtual feature must be used when querying the Property of a Block.

Using the directAssociatedProperty Virtual Feature

The following example illustrates what you need to do to use directedAssociatedProperty.

1. In line two, the maplembse ecore is imported with an alias.
2. Use an ownedAttribute[Property] as the queried dimension.
3. Make a reference-query to a class using mse::directedAssociatedProperty.
Example

```java
import-ecore "http://www.nomagic.com/magicdraw/UML/2.5"
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source structurePkg = Root/packagedElement[Package]
data-source cls = structurePkg/packagedElement[Class]

synctable-schema ClassTableSchema {
  dim [Class] {
    key column /name as className
  }
}

synctable-schema ClassTreeTableSchema(blocks: ClassTableSchema) {
  record dim [Class] {
    key column /name as className1
  }
  dim /ownedAttribute(Property).mse::directedAssociatedProperty[Class] @ cls {
    reference-decomposition cls = cts {
      foreign-key column ClassName as referredClassName
    }
  }
}

synctable classTableSchema = ClassTableSchema<cls>
synctable classTreeTableSchema = ClassTreeTableSchema<cls>(classTableSchema)

worksheet-template ClassTable(cts: ClassTableSchema) {
  vertical table tab1 at (6, 2) = cts {
    key field ClassName : String
    key field Name4 : String
  }
}

worksheet-template ClassTreeTable(ctt: ClassTreeTableSchema) {
  vertical table tab1 at (6, 2) - ctt {
    key field ClassName1 : String
    key field referredClassName : String
  }
}

workbook{
  worksheet ClassTable(classTableSchema)
  worksheet ClassTreeTable(classTreeTableSchema)
}
```

Figure 3.2: directAssociatedProperty Example
3.3 otherAssociatedEnd

Description

otherAssociationEnd is used in the case when two classifiers has to be linked and the information about the properties of these classifiers are owned by the association and not the classifiers themselves, such as in the case of UseCase diagram where association exist between an actor and usecase and these two classifiers does not own any property that defines the other classifier.

Syntax

The general syntax for using the otherAssociationEnd virtual feature is as follows:

```
.alias::otherAssociationEnd
```

Where alias is the alias you assigned to the MapleMBSE ecore (hyperlink to above).

The otherAssociationEnd virtual feature must always be used when querying a Class.

Using the otherAssociatedEnd Virtual Feature

The following example illustrates what you need to do to use otherAssociationEnd.

1. In line two, the maplembse ecore is imported with an alias.
2. Use when a Class as the queried dimension.
3. Make a reference-query to a class using mse::otherAssociationEnd, unlike other virtual features in this section otherAssociationEnd should not be used when a property is queried.
Example
Figure 3.3: otherAssociatedEnd Example

```
import-econ "http://www.nomagic.com/magicdraw/UML/2.5"
import-econ "http://maplembe.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source useCasePkg = Root/packagedElement[Package]
data-source actors = useCasePkg/packagedElement[Actor]
data-source useCases = useCasePkg/packagedElement[UseCase]

synctable-schema ActorsTable {}
  record dim [Actor] {
    key column /name as Actor
  }

synctable-schema UseCasesTable(ac:ActorsTable) {}
  record dim [UseCase] {
    key column /name as Name
    reference-query .mse::otherAssociationEnd[Actor] @ actor
    reference-decomposition actor = ac {
    foreign-key column Actor as Actor
  }

synctable actorsTable = ActorsTable<actors>
synctable useCasesTable = UseCasesTable<useCases>(actorsTable)

worksheet-template Actors(ac: ActorsTable) {
  vertical table tab1 at (5, 3) = ac {
    key field Actor : String
  }
}

worksheet-template UseCases(auct: AssociatedUseCasesTable) {
  vertical table tab1 at (5, 3) = auct {
    key field Name : String
    key field Actor : String
  }
}

workbook {
  worksheet Actors(actorsTable)
  worksheet UseCases(useCasesTable)
}
```
4 Connectors

A Connector is used to link ConnectableElements (for example, Ports or Properties) of a Class through a ConnectorEnd. A Connector has two ConnectorEnds.

Based on the connection between Properties of a Class the connection can be of two types: Delegation (connecting Ports or Properties from the system to Ports or Properties inside a Class) or Assembly (connecting Ports or Properties within a Class).

4.1 connectedPropertyOrPort

Description

To achieve this connection MapleMBSE uses connectedPropertyOrPort virtual feature.

The connectedPropertyOrPort virtual feature connects Ports or Properties of a Class. It automatically detects the kind of relation required between the Properties being connected and creates the appropriate connection.

When MapleMBSE queries the model, the connectedPropertyOrPort return the list of target properties.

Syntax

The general syntax for using the connectedPropertyOrPort virtual feature is as follows:

```
.alias::connectedPropertyOrPort
```

Where the alias is alias you assigned to MapleMBSE ecore.
When the connection is created through `connectedPropertyOrPort`, the owner of the connected `Property` is determined automatically by MapleMBSE, regardless of whether this is a `Delegation` or `Assembly` type connection.

**Using the connectedPropertyOrPort virtual feature**

In general, to use the `connectedPropertyOrPort` virtual feature:

1. First, import the MapleMBSE ecore with alias
2. Use an ownedAttribute[Property] as the queried dimension.
3. Make a reference-query to a property using `mse::connectedPropertyOrPort`.

**Example**

A specific example of how to use the `ConnectedPropertyOrPort` virtual feature is shown below.

```java
import-ecore "http://www.nomagic.com/magicdraw/UML/2.5"
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse

syntax schema BlocksTable {
    record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
        key column /name as BlockName
    }

    dim /ownedAttribute[Property] {
        key column /name as PropertyName
    }
}

syntax schema ConnectedPropertyOrPortTable(bT: BlocksTable) {
    record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
        key column /name as className
    }

    record dim /ownedAttribute[Property] {
        key column /name as ParentPort
    }

    record dim .mse::connectedPropertyOrPort @ cls {
        reference-decomposition cls = bT {
            foreign-key column BlockName as referredClassName
            foreign-key column PortName as referredPortName
        }
    }
}
```

Figure 4.1: connectedPropertyOrPort Example
4.2 otherConnectorEnd

Description

To achieve this connection MapleMBSE also use otherConnectorEnd virtual feature. This virtual feature can connect between ports or properties of a class, otherConnectorEnd automatically create the relation required between the properties being connected and creates appropriate connection.

When MapleMBSE queries the model, the otherConnectorEnd return the list of connectorEnds which is associated with the property.

Syntax

The general syntax for using the otherConnectorEnd virtual feature is as follows:

```
.alias::otherConnectorEnd
```

Where the alias is the alias you assigned to the MapleMBSE ecore.

When the connection is created using otherConnectorEnd, the owner of the connected Property is determined automatically by MapleMBSE, regardless of whether this is a Delegation or Assembly type connection.

Using the otherConnectorEnd Virtual Feature

How to use the otherConnectorEnd virtual feature is shown in the example below:

1. First, import the MapleMBSE ecore with an appropriate alias
2. Use an ownedAttribute[Property] as the queried dimension.
3. Make a reference-query to a property using mse::otherConnectorEnd.

Example

A specific example of how to use the otherConnectorEnd virtual feature is shown below.
Figure 4.2: otherConnectorEnd Example
5 Dependencies

A *Dependency* is used between two model elements to represent a relationship where a change in one element (the supplier element) results in a change to the other element (client element).

A *Dependency* relation can be created between any *namedElement*. Different kinds of *Dependencies* can be created between the model elements such as *Refine*, *Realization*, *Trace*, *Abstraction* etc.,

5.1 clientDependencies

**Description**

The *clientDependencies* virtual feature creates a relation between the client being the dependent and supplier who provides further definition for the dependent.

**Syntax**

The general syntax for using the *clientDependencies* virtual feature is as follows:

```
/mse::clientDependencies
```

This virtual feature is used while querying a Class that has to be assigned as client to the dependency that is being created and is used in a following dimension the class that is being queried.

Where *alias* is the alias you assigned to the MapleMBSE ecore.

**Using the clientDependencies Virtual Feature**

In general, the following steps outline how to use *clientDependencies*:

1. It should be used when a named element is queried

2. Information about the type of relationship is specified as *[Dependency],[Abstraction]* etc.,

3. When querying the model element with *mse::clientDependencies*, the reference decomposition should be to a supplier element.

**Example**

The example below is an illustration of how to use the *clientDependencies* virtual feature.
5.2 supplierDependencies

Description
Similar to clientDependencies, supplierDependencies is used to create a relation between two named elements. The only difference between the two virtual features is supplierDependencies is used when the relationship has to be made from supplier to client instead of client to supplier, as in the case of clientDependencies.

**Syntax**

The general syntax for using the supplierDependencies virtual feature is as follows:

```
/mse::supplierDependencies
```

This virtual feature is used while querying a Class that has to be assigned as supplier to the dependency that is being created and is used in a dimension following the class that is being queried.

Where alias is the alias you assigned to the MapleMBSE core.

**Using the supplierDependencies Virtual Feature**

The following example illustrates what you need to do to use supplierDependencies

1. It should be used when a named element is being queried.
2. Information about the type of relationship is specified as [Dependency], [Abstraction] etc.,
3. When querying the model element with mse::supplierDependencies the reference decomposition should be to a client element.
Example

```java
import.ecore "http://www.nomagic.com/magicdraw/UML/2.5"
import.ecore "http://maplebse.maplesoft.com/common/1.0" as msc

data-source Root[Model]
data-source package = Root/package[Package[name="Package"]]
data-source cls = package/package[Class[msc:metaclassName="SysML::Requirements::Requirement"]]

synctable schema RequirementsTableSchema {
  record dim [Class[msc:metaclassName="SysML::Requirements::Requirement"]] {
    key column /name as ReqName
  }
}

synctable schema RequirementsDerivesTableSchema(reqs:RequirementsTable) {
  record dim [Class[msc:metaclassName="SysML::Requirements::Requirement"]] {
    key column /name as ReqName
  }
  record dim /msc:supplierDependencies[Abstraction][msc:metaclassName="SysML::Requirements::DeriveReq"] {
    key reference-query .client @ reqDecomp
    reference-decomposition reqDecomp -> reqs {
      foreign-key column ReqName as DeriveName
    }
  }
}

synctable requirementsTableSchema = RequirementsTableSchema(cls)
synctable requirementsDerivesTableSchema = RequirementsDerivesTableSchema(cls)(requirementsTable)

worksheet-template ReqClassTable(cts:RequirementsTableSchema){
  vertical table tabl at (4,5) = cts{
    key field Name : String
  }
}

worksheet-template ReqClassDependency(cds:RequirementsDerivesTableSchema){
  vertical table tabl at (6,5) = cds{
    key field Name : String
    key field DeriveName : String
  }
}

workbook{
  worksheet ReqClassTable(requirementsTableSchema)
  worksheet ReqClassDependency(requirementsDerivesTableSchema)
}
```

Figure 5.2: supplierDependencies Example
6 Enumeration

Enumeration is a special DataType that can be compared to a list of possible values, the way that "colors" can be an enumeration and possible values can be: red, blue, green, etc. These Enumerations are composed of EnumerationLiterals which are the different values and the actual Elements to be referenced. MapleMBSE supports a couple virtual features that need to be used in conjunction to access and reference any Enumeration and its EnumerationLiterals independently of where in the TWCloud project those values are stored (for example, under Model or customized profile).

6.1 EnumerationName

Description

MapleMBSE, to simplify Enumeration identification, supports an enumerationName virtual feature that allows simpler access to a specific Enumeration while creating an mse configuration. Note that MapleMBSE, while using this virtual feature, will by default instantiate the accessed Element to the first EnumerationLiteral of the Enumeration. Nonetheless, enumerationLabel can be used to change to another EnumerationLiteral. See the next section for further details.

Syntax

The general syntax for using the enumerationName virtual feature is as follows:

```
alias::enumerationName="qualified::name"
```

Where alias is the alias you assigned to the MapleMBSE ecore and qualified::name is the qualifiedName of the Enumeration. For more information on assigning aliases, see Importing the MapleMBSE Ecore (page 3).

The enumerationName virtual feature must be used while querying an Element with a Stereotype that support some Property with an Enumeration type. For more information how to access a Slot, see the sections in the guide on the metaclassName and featureName virtualFeatures. Once you get the specific Slot, retrieve its value and within its Qualifier filter use enumerationName.

Using the VertexTransition Virtual Feature

The following example illustrates what you need to do to use the enumerationName virtual feature:

1. Import the maplembse ecore with an alias.

2. Create a schema that takes an Element with a Stereotype and navigate down to its InstanceValue for a Property with an Enumeration type. See lines 15 to 18 in the example code in the next section for an illustration.
3. Make sure you are using the right combination of qualified names for Stereotypes, Slot Properties and Enumeration.

4. Complete the /value[InstanceValue] navigation with an enumerationLabel (see next section for further details).

Example

```java
import.ecore "http://www.nomagic.com/magicdraw/SPL/2.5"
import.ecore "http://maplembse.maplesoft.com/common/1.0" as ecore

Workbook {
  worksheet EnumerationTemplate(enums)
}

data-source Root[Model]
  data-source reqs = Root[package][package.name=\"Euml\"]
    /packageElement[class][mbe:metaclassName=\"SysML:Non-Normative Extensions::Requirement::extendedRequirement\"] {
      syntable-schema Enumschema {
        key column /name as Name
        column /appliedStereotypeInstance[InstanceSpecification]
          /Slot[me:featureName=SysML:Non-Normative Extensions::Requirement::extendedRequirement::verifyMethod]
          /value[InstanceValue][me:enumerationName=SysML:Non-Normative Extensions::Requirement::VerificationMethodKind]
          /mbe:enumerationLabel as verificationMethod
      }
    }
  }

syntable enums = Enumschema(reqs)

worksheet template EnumerationTemplate (es: Enumschema) {
  vertical table tabl at (i, j) = es {
    key field FName
    field verificationMethod
  }
}
```

6.2 EnumerationLabel

Description

As shown in the previous sections on EnumerationName, MapleMBSE allows you to make a reference to Enumeration using a qualifiedName. However, without the right mechanism to translate from String to EnumerationLiterals and vice versa, the end user will be forced to deal with strange Object references or unusable Excel cells. This is exactly the problem enumerationLabel was designed to solve. Using this virtual feature allows the end user to see the String name of the EnumerationLiteral without forcing any reference-decomposition and it allows also the end user to change the reference from the Slot Property using the String name of the desired EnumerationLiteral.

Syntax

The general syntax for using the enumerationLabel virtual feature is as follows:

```
/alias::enumerationLabel
```

Where alias is the alias you assigned to the MapleMBSE ecore. For more information on assigning aliases, see Importing the MapleMBSE Ecore (page 3).

The enumerationLabel virtual feature must be used while querying an InstanceValue with a Stereotype that support some Property with a Enumeration type and its was filtered
with `enumerationName`. For more information how to access this kind of `InstanceValue` see previous section.
7 Util

This section contains all other virtual features that do not create elements but offer a better alternative to access and map model information.

7.1 multiplicityProperty

Description

The UML specification contains several MultiplicityElements like Properties that have upper and lower features to describe their multiplicity. Use the multiplicityProperty virtual feature to make a configuration that translates a string into those upper and lower values and the other way around.

This virtual feature recognizes the UML commonly used notation for multiplicity (e.g. 0..*). Supporting this notation makes MapleMBSE much easier to use without adding complexity and thus the final user has less to input into Excel.

Syntax

The general syntax for using the multiplicityProperty virtual feature is as follows:

(alias::multiplicityProperty)

Where the alias is the alias you assigned to the MapleMBSE core.

This virtual feature can only be used while querying a concrete EClass implementing a MultiplicityElement like a Property or a Pin. A slash notation is needed prior to the alias, the 2 colons, and multiplicityProperty.

As mention previously multiplicityProperty uses a string to represent the multiplicity, meaning that this particular virtual feature cannot being used as a dimension with a qualifier. It is intended to be used only at a column declaration.

Using the multiplicityProperty Virtual Feature

The following example shows you how to map the multiplicity of a concrete MultiplicityElement like Property and a string.

1. Import the MapleMBSE core, as usual the alias used is mse

2. Inside a syntable-schema navigate to a MultiplicityElement, in this case /ownedAttribute/Property/ within a Class

3. Within that dimension, define a regular column using /mse::multiplicityProperty
4. Complete the rest of the configuration as usual: worksheet-templates, synctable and workbook

Example

import.ecore "http://www.nomagic.com/magicdraw/UML/2.5"
import.ecore "http://maplembse.maplesoft.com/common/1.0" as mser

data-source Root[Model]
data-source classes = Root/packagedElement[Class]

synctable-schema Schema {
record dim [Class] {
  key column /name as cName
}

  record dim /ownedAttribute[Property] {
    key column /name as pName
    column /mse::multiplicityProperty as multiplicity
  }
}

worksheet-template Template(sch: Schema) {
  vertical table tab1 at (2, 2) = sch {
    key field cName : String
    key field pName : String
    field multiplicity : String
    sort-keys cName, pName
  }
}

synctable tableProperty = Schema<classes>
workbook {
  worksheet Template(tableProperty)
}

Figure 7.1: multiplicityProperty Example
8 Activity Diagrams

An Activity Diagram is a diagram with a direct connection, ActivityEdge that connects a node, ActivityNode to another ActivityNode. An Activity Diagram is useful to abstract behavioral information within a system. In order to improve MSE configurations, MapleMBSE supports control and object flow, the 2 kind of ActivityEdges, with 2 distinct virtual features.

8.1 ActivityControlFlow

Description

A ControlFlow is an ActivityEdge that is used to control the execution of ActivityNodes within an Activity. Note that MapleMBSE will fail to instantiate abstract classes like ActivityNode and it will be required to instantiate instead concrete classes like CallAction-Behavior, ActivityParameterNode or InitialNode. Nonetheless, ActivityNodes can be used as a reference to create ControlFlows. See the example section for further details.

Syntax

The general syntax for using the activityControlFlow virtual feature is as follows:

```
_alias:: activityControlFlow
```

Where alias is the alias you assigned to the MapleMBSE ecore. For more information on assigning aliases, see Introduction#LoadingVF

The activityControlFlow virtual feature must be used when querying the ActivityNode of Activity.

Using the ActivityControlFlow Virtual Feature

The following example illustrates what you need to do to use activityControlFlow virtual feature:

1. Import the maplembse ecore with an alias.
2. Create an schema that navigates till an ActivityNode or which first dimension is an ActivityNode.
3. Make a dimension reference-query to another ActivityNode using .mse::activityControlFlow.

This example has extra schema, CallBehaviorActionSchema used to create concrete ActivityNodes. The other schemas in this example will fail to instantiate Element because ActivityNode is an abstract class.
Note: Some data sources specific to a fictional project were created to simplify the reference-decomposition. In a real life scenario you might need to identify the Package, the Activity and the ActivityNode that you want to connect to.

Example

```java
import-eCore "http://www.nomagic.com/magicdraw/UML/2.5"
import-eCore "http://maplesoft.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source pkg = Root/packagedElement[Package|name = "controlflow"]
data-source activities = pkg/packagedElement[Activity|name="activity"]
data-source nodes = activities/node[ActivityNode]
data-source cb = activities/node[CallBehaviorAction]

syncable-schema NodeSchema {
  dim [ActivityNode] {
    key column /name as nName
  }
}

syncable-schema CallBehaviorActionSchema {
  dim [CallBehaviorAction] {
    key column /name as nName
  }
}

worksheet-template CallBehaviorActionTemplate (cbasc: CallBehaviorActionSchema) {
  vertical table tabl at (2, 1) = cbasc {
    key field nName
  }
}

syncable-schema Schema(nsc: NodeSchema) {
  dim [ActivityNode] {
    key column /name as nName
  }
  dim .mse::activityControlFlow[ActivityNode] @ tgtNode {
    reference-decomposition tgtNode = nsc {
      foreign-key column nName as tgtNode
    }
  }
}
```

Figure 8.1: ActivityControlFlow Example
8.2 ActivityObjectFlow

Description

An ObjectFlow is an ActivityEdge that is used to represent the flow of an object between ActivityNodes within an Activity. Due to some UML specifications, some ActivityNodes cannot be connected directly with an ObjectFlow; they required Pins. In parallel to those Pins, if one of those ActivityNodes is a CallBehaviorAction further detailed using another Activity, and then the following Objects must be synchronized in number and direction: Pins, ActivityParameterNode and Parameters. This synchronization is automatically supported by MapleMBSE so be aware of the creation of those Elements.

Syntax

The general syntax for using the activityObjectFlow virtual feature is as follows:

```json
.alias:: activityObjectFlow
```

Where alias is the alias you assigned to the MapleMBSE ecore. For more information on assigning aliases, see Introduction (page 1).

The activityObjectFlow virtual feature must be used when querying the ActivityNode of Activity.

Using the ActivityObjectFlow Virtual Feature

The following example illustrates what you need to do to use activityObjectFlow virtual feature:

1. Import the maplembse ecore with an alias.

2. Create a schema that navigates till an ActivityNode or which first dimension is an ActivityNode.


Example

```java
import-eorc "http://www.nomagic.com/magicdraw/UML/2.5"
import-eorc "http://maplembse.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source pkg = Root/packagedElement[Package|name = "objectflow"]
data-source activities = pkg/packagedElement[Activity|name="activity"]
data-source nodes = activities/node[ActivityNode]

synctable-schema NodeSchema {
  dim [ActivityNode] {
    key column /name as nName
  }
}

synctable-schema Schema(nsc: NodeSchema) {
  dim [ActivityNode] {
    key column /name as nName
  }

  dim .mse::activityObjectFlow[ActivityNode] @ tgtNode {
    reference-decomposition tgtNode = nsc {
      foreign-key column nName as tgtNode
    }
  }
}

worksheet-template Template (sc: Schema) {
  vertical table tab1 at (2, 1) = sc {
    key field nName
    key field tgtNode
  }
}

synctable nodeTable = NodeSchema<nodes>
synctable controlFlowTable = Schema<nodes>(nodeTable)

workbook {
  worksheet Template(controlFlowTable)
}
```

Figure 8.2: ActivityObjectFlow Example
9 StateMachines

StateMachine diagrams are used to define the different states that a system will exist in. This kind of diagram helps modelers to describe discrete, event-driven behaviors of the whole system or its parts.

9.1 VertexTransition

Description

MapleMBSE, in order to simplify Transition between Vertexes, supports a vertexTransition virtual feature that allows a better end user experience while inputting data. Note that MapleMBSE will fail to instantiate abstract classes like Vertex and it will be required to instantiate instead concrete classes like Pseudostate, State or FinalState. Nonetheless, Vertex can be used as reference to create Transitions. See the example section for further details.

Syntax

The general syntax for using the vertexTransition virtual feature is as follows:

```
.alias:: vertexTransition
```

Where alias is the alias you assigned to the MapleMBSE ecore. For more information on assigning aliases, see Importing the MapleMBSE Ecore (page 3).

The vertexTransition virtual feature must be used when querying the any kind of Vertex within a given Region of a StateMachine.

Using the VertexTransition Virtual Feature

The following example illustrates what you need to do to use the vertexTransition virtual feature:

1. Import the maplembse ecore with an alias.
2. Create an schema that navigates till an Vertex or which first dimension is an Vertex.
3. Make a dimension reference-query to another Vertex using .mse:: vertexTransition.

This example has some extra schema, called StateSchema, used to create concrete States. The other schemas in this example will fail to instantiate Element because Vertex is an abstract class.

Note: some data sources specific to a fictional project were create in order to simplify the reference-decomposition, in a real life scenario you might need to identify the Package, the StateMachine, the Region and the Vertex that you want to connect to.
Example

```java
import ecore "http://www.nomagic.com/magicdraw/UML/2.5"
import ecore "http://maplembc.maplesoft.com/ceemon/1.9" as mce

data-source Root<Model>
data-source pkg = Root/packageElement[Package[name="stateMachine"]]
data-source stm = pkg/packageElement[StateMachine[name="stm"]]
data-source rg = stm/region[Region[name="rg"]]
data-source vertexes = rg/subvertex[Vertex]
data-source states = rg/subvertex[State]

@syncable-schema VertexSchema {
  dim [Vertex]
  key column /name as vName
}

@syncable-schema StateSchema {
  dim [State]
  key column /name as vName
}

worksheet-template StateTemplate(ssc: StateSchema) {
  vertical table tab1 at (2, 1) = ssc {
    key field vName
  }
}

worksheet-template Schema(vsc: VertexSchema) {
  dim [Vertex]
  key column /name as vName

  dim .mce:vertexTransition[Vertex] @ tgtRef {
    reference-decomposition tgtRef = vsc {
      foreign key column vName as tgtVertex
    }
  }
}

worksheet-template Template(sci: Schema) {
  vertical table tab1 at (2, 1) = sci {
    key field vName
    key field tgtVertex
  }
}

syncable vertexTable = VertexSchema.vertexes
syncable stateTable = StateSchema states
syncable transitionTable = Schema.vertexes(vertexTable)

workbook {
  worksheet StateTemplate(stateTable)
  worksheet Template(transitionTable)
}
```

Figure 9.1: VertexTransition Example