MapleMBSE 2021.2 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 2021 requires the following products.

- Microsoft® Excel® 2010 Service Pack 2, Excel 2016 or Excel 2019.
- 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 specifed 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, 8.3 and 8.4
- Teamwork Cloud™ server 18.5 SP3 or 19.0 SP4

If you are using Eclipse Capella™ with MapleMBSE, the following version is supported:

- 1.4.0

If you are using Eclipse™,the following version is supported:

- 2020-3

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

Resource	Description
MapleMBSE Installation Guide	System requirements and installation instructions for MapleMBSE. The **MapleMBSE Installation Guide** is available in the **Install.html** file located either on your MapleMBSE installation DVD or the folder where you installed MapleMBSE.
MapleMBSE Applications	Applications in this directory provide a hands on demonstration of how to edit and construct models using MapleMBSE. They, along with an accompanying guide, are located in the Application subdirectory of your MapleMBSE installation.
MapleMBSE Configuration Guide	This guide provides detailed instructions on working with configuration files and the configuration file language.
MapleMBSE User Guide	Instructions for using MapleMBSE software. The **MapleMBSE User Guide** is available in the folder where you installed MapleMBSE.
Frequently Asked Questions	You can find MapleMBSE FAQs here: https://faq.maplesoft.com
Release Notes	The release notes contain information about new features, known issues and release history from previous versions. You can find the release notes in your MapleMBSE installation directory.

For additional resources, visit **http://www.maplesoft.com/site_resources**.

Getting Help

To request customer support or technical support, visit **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 familar with UML, SysML and Model-based Systems Engineering concepts and who intend to create their own MapleMBSE configuration files.

1.2 Prequisite 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 Facility 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).

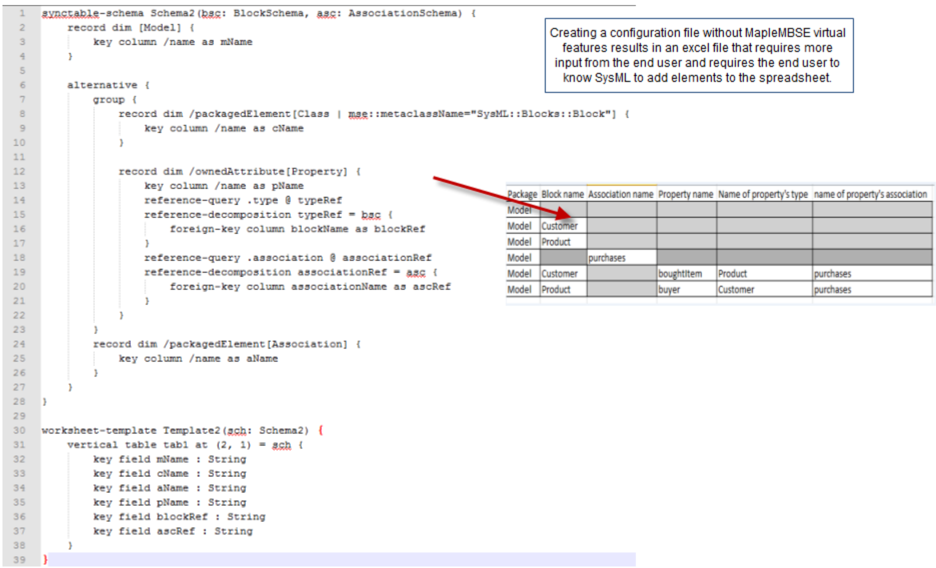
Many different concrete and abstract *Classifiers*, with very specific semantics, are part of the SysML technical specifications. These *Classifiers* should not be used interchangeably. Even "linking" elements changes depending on the "linked" elements. For example, SysML *Associations* are to *Classes* 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.

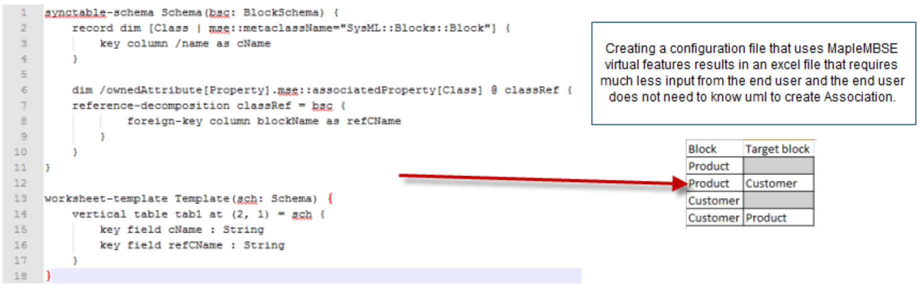
With the right choice of labels within an Excel template and a well designed configuration (.mse) file that implements MapleMBSE virtual features, an end user can enter a couple of inputs in a spreadsheet and create *Blocks* and the Associations linking them, or Ports and Connectors, or other combinations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

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 symbol and the qualified name of the *Stereotype* between quotation marks.

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 the metaclassName 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*.

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

synctable-schema BlockSchema {
    record dim [Class | mse::metaclassName="SysML::Blocks::Block"] {
        key column /name as bName
    }
}

synctable-schema RequirementSchema {
    record dim [Class | mse::metaclassName="SysML::Requirements::Requirement"] {
        key column /name as rName
    }
}

worksheet-template BlockTemplate (bsc: BlockSchema) {
    vertical table tab1 at (1, 1) = bsc {
        key field bName: String
    }
}

worksheet-template RequirementTemplate(rsc: RequirementSchema) {
    vertical table tab1 at (1, 1) = rsc {
        key field rName: String
    }
}

synctable blockTable = BlockSchema<blocks>
synctable 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*.

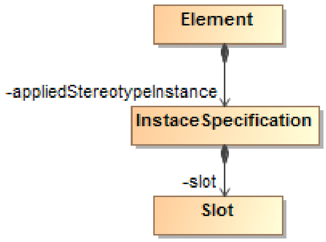


Figure 2.2: A The appliedStereotypeInstance Structure

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 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 synctable-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

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 synctable-schema for *Requirements*. **Note**: use the same qualifier and *Stereotype* for the first `dimension` as 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`, `synctable` and `workbook`.

```
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 requirements = Root/packagedElement[Class | mse::metaclassName="SysML::Requirements::Requirement"]


synctable-schema RequirementSchema {
    record dim [Class | mse::metaclassName="SysML::Requirements::Requirement"] {
        key column /name as rName
        column /appliedStereotypeInstance[InstanceSpecification]/slot[Slot|mse::featureName=
          "SysML::Requirements::Requirement::Text"]/value[LiteralString]/value
            as spec
    }
}

worksheet-template RequirementTemplate(rsc: RequirementSchema) {
    vertical table tab1 at (1, 1) = rsc {
        key field rName: String
        field spec: String
    }
}

synctable requirementTable = RequirementSchema<requirements>

workbook {
    worksheet RequirementTemplate(requirementTable)
}
```

Figure 2.3: featureName Example

2.3 stereotypeNames

Description

Use the **stereotypeNames** virtual feature to filter and create *Model Elements* with the specific combination of *Stereotypes*. To use this virtual feature you need a complete and necessary list of *Stereotypes* and their qualified names, and concatenate those qualified names into a single String. Only *Elements* which *Stereotypes* match in number and in qualified name are accepted by this filtering. The order of those *Stereotypes* is not important.

Syntax

This virtual feature is used as a attribute filter inside the qualifier and it does not require a dot or slash. The **stereotypeNames** virtual feature must be followed by an equal symbol and a String with *Stereotypes*. That String must separate the *Stereotypes* qualified names with a comma to work properly.

```
alias::stereotypeNames="one::qualified::name,another::quali-
fied::name"
```

It is important to know that the order of the qualified names are not important. They can be swapped and the same result is to be expected. On the other hand, the String must include the exact number of *Stereotypes* the filter should use. Meaning if you have a model with N *Elements* with *Stereotypes* A and B, filtering using the String "A;B;C" would not show any of those N *Elements* as they do not have the same number of *Stereotypes*.

Using the stereotypeNames Virtual Feature

The following steps illustrate what you need to use the stereotypeNames virtual feature:

1. The MapleMBSE ecore is imported and its alias is mse.
2. A couple data-sources are used for this example with `stereotypNames` to filter *Packages* and *Classes*.
3. To use this feature to apply *Stereotypes*, you need to define a `synctable-schema`. **Note**: To avoid problems with MapleMBSE it is a good practice to use the same qualifier and *Stereotypes* 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 `stereotypeNames` to create and filter *Elements* with different *Stereotypes*.

```
import-ecore "http://www.nomagic.com/magicdraw/UML/2.5.1"
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse

workbook {
    worksheet ActivityTable(functionalTableSchema)
    worksheet FunctionFMEAMatrix(functionalFMEASchema,functionalTableSchema,fMEATableSchema)
    worksheet FunctionsFMEATable(functionalFMEASchema)
    worksheet FMEARequirementTable(fMEARequirementSchema)
    worksheet DerivedFMEARequirementTable(derivedFMEARequirementSchema)
    worksheet RequirementFMEAMatrix(derivedFMEARequirementSchema, fMEARequirementSchema, fMEATableSchema)
}


data-source Root[Model]
data-source pkg = Root/packagedElement[Model|name = "Model-UAVSystem"]/packagedElement[Package|name = "System Behavior"]
data-source act = pkg/packagedElement[Activity]
data-source fmea = pkg/packagedElement[Package|name = "FMEA"]/packagedElement[Class|mse::stereotypeNames="CustomStereotypes::FMEA"]
data-source fmeaR = pkg/packagedElement[Package|name = "FMEA"]/packagedElement[Package|name = "FMEARequirement"]
                    /packagedElement[Class|mse::stereotypeNames="CustomStereotypes::FMEARequirement,SysML::Requirements::AbstractRequirement"]


synctable-schema FunctionalTableSchema{
    record dim[Activity]{
        key column /name as actName
    }
}

synctable-schema FMEARequirementSchema{
    record dim[Class|mse::stereotypeNames="CustomStereotypes::FMEARequirement"]{
        column /name as ReqName
        key column /appliedStereotypeInstance[InstanceSpecification]
            /slot[Slot|mse::featureName="SysML::Requirements::AbstractRequirement::Id"]/value[LiteralString]/value as ReqID
        column /appliedStereotypeInstance[InstanceSpecification]
            /slot[Slot|mse::featureName="SysML::Requirements::AbstractRequirement::Text"]/value[LiteralString]/value as ReqSpecification
    }
}

....

```

Figure 2.4: stereotypeNames Example

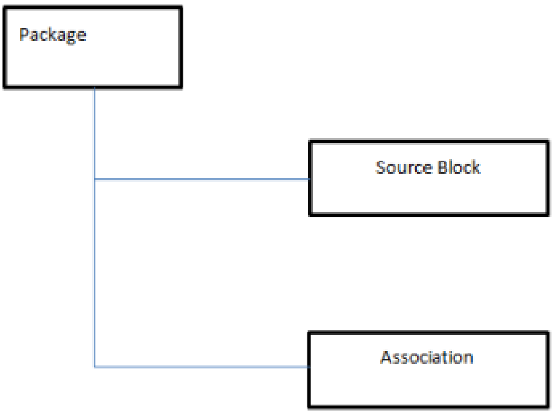
3 Associations

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 hierarchicallevel 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 lllustrates 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`.
4. Complete the `reference-decomposition`.

Example

```
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 clss = 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::associatedProperty[Class] @ cls {
        reference-decomposition cls = cts {
        foreign-key column ClassName as referredClassName
        }
    }
}

synctable classTableSchema = ClassTableSchema<clss>
synctable classTreeTableSchema = ClassTreeTableSchema<clss>(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 3.1: 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 a*ggregation* 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 lllustrates 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`.
4. Complete the `reference-decomposition`.

Example

```
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 clss = 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<clss>
synctable classTreeTableSchema = ClassTreeTableSchema<clss>(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 assocaition 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 lllustrates 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 querried.
4. Complete the `reference-decomposition`.

Example

```
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 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)
}
```

Figure 3.3: otherAssociatedEnd Example

3.4 nestedDirectedComposition

Description

MapleMBSE is powerful enough to change any SysML feature, in particular a *nestedClassifier*. The effort to change the model in a desired way is always related to creating the right schemas and data sources to offer intuitive views. Unfortunately, creating a nested block and a directed composition to it is not an easy task without this virtual feature. The creation of composition association to non-existing nested block should be possible just by mentioning the name of the target block in the right dimension.

Syntax

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

dim */alias::nestedDirectedComposition*[Association]

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

The *nestedDirectedComposition* virtual feature must be used when querying the *Block* and *Association* in a dimension. It always needs to be used in conjuction with another virtual feature to set up the target *Block*: *targetBlockName.*

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

key column /alias::targetBlockName

This *targetBlockName* virtual feature should be the only key column for a *nestedDirectedComposition* dimension.

Using the nestedDirectedComposition virtual feature

The following example lllustrates what you need to do to use *nestedDirectedComposition*

1. In line two, the **maplembse ecore** is imported with an alias.
2. Use a *Class* or an *Association* qualifier in the querried dimension, as shown in line 8, 12 and 16.
3. Create a *targetBlockName* key column for each *nestedDirectedComposition dimension*

Example

```
data-source Root[Model]

data-source blocks = Root
/packagedElement[Package|name="Structure"]
/packagedElement[Class|mse::metaclassName="SysML::Blocks::Block"]

synctable-schema Schema {
    record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
        key column /name as bName
    }

    record dim /mse::nestedDirectedComposition[Association] {
        key column /mse::targetBlockName as nbName
    }

    record dim /mse::nestedDirectedComposition[Association] {
        key column /mse::targetBlockName as nbName2
    }

}

worksheet-template Template(sc: Schema){
    vertical table tab1 at (4,2) = sc {
        key field bName
        key field nbName
        key field nbName2
        sort-keys bName, nbName, nbName2
    }
}

synctable blockTable = BlockSchema<rBlocks>
synctable dataTable = Schema<blocks>
synctable associatedDataTable = AssociatedPropertySchema<blocks>(blockTable)

workbook {
    worksheet Template(dataTable) {label="Nested Classifier"}
}
```

4 Blocks

4.1 recursivePartProperties

Description

The recursivePartProperties virtual feature helps finds all the related blocks and sub-blocks and part properties, recursively.

Displaying a block and related sub-blocks in the same syncview is difficult if they are in different packages, and there is a chance that relevant blocks are missing in the syncview. The recursivePartProperties virtual feature helps find all the related blocks, sub-blocks and part properties, recursively. This makes it easier to create a corresponding configuration file.

The recursivePartProperties virtual feature works in a similar fashion to recursiveInstance-WithSlots, and a common use case is to use both of these in conjunction for instance matrices.

Syntax

The configuration file syntax for using recursivePartProperties is illustrated below.

```
datasource blocks = Root/packageElement[Pack-
age|name="Test"]/packageElement[Class|name="B1"]/mse::recurs-
ivePartProperties[Class];
synctable-schema TestSchema {
record dim[Class]{
key column /name as mainBlock
}
Dim /mse::recursivePartProperties[Class]{
Key column /name as subBlocks
}
}
```

Using the recursivePartProperties Virtual Feature

The following example illustrates one way to use the recursiveIPartProperties virtual feature:

1. Import the MapleMBSE ecore with an alias.
2. Create a datasource that has the context/main block for which you want to find the properties(for example, `../packageElement[Class|name="B1"]`).
3. Use `recursivePartProperties[Class]` toreturn all the classes linked to the context/main block and sub blocks.

4. Create a `sync-schema` and `synctable` and after that use that datasource in the synctable.

Example

```
datasource blocks = Root/packageElement[Pack-
age|name="Test"]/packageElement[Class|name="B1"]/mse::recurs-
ivePartProperties[Class];
```

4.2 propertyDefaultValue

Description

Previously, to view or edit the default value of the value property or property without any Stereotype, the author/editor of the configuration file editor had to write the line column /value[LiteralReal]/value. If the property contains a value other than a real value then MapleMBSE will not display this value in the cell. If the configuration editor were to write the MSE file in such a way as to view the value of every type of value property, It will complicate the MSE file and still, the end user will not able to view the values in one single column. The propertyDefaultValue virtual feature fixes this problem and helps the configuration file editor and the end user to view and edit the value in one column.

Syntax

/mse::propertyDefaultValue

Using the propertyDefaultValue Virtual Feature

1.Import the MapleMBSE ecore with an alias.
2. Create a datasource that has the blocks/classes for which you want to find the properties(for example, `../packageElement[Class]`).
3. Use `ownedAttribute[Property]` to get properties from the block/Class
4. Use the `propertyDefaultValue` to get the value from the property

5. Create a `sync-schema` and `synctable` and then use that datasource in the synctable.

Example

```
synctable-schema Schema{
 record dim [Class|mse::metaclassName="SysML::Blocks::Block] {
 key column /name as BlockName
 }
 record dim /ownedAttribute[Property mse::metaclassName |="MD Customization
 for SysML::additional_stereotypes::ValueProperty"] {
```

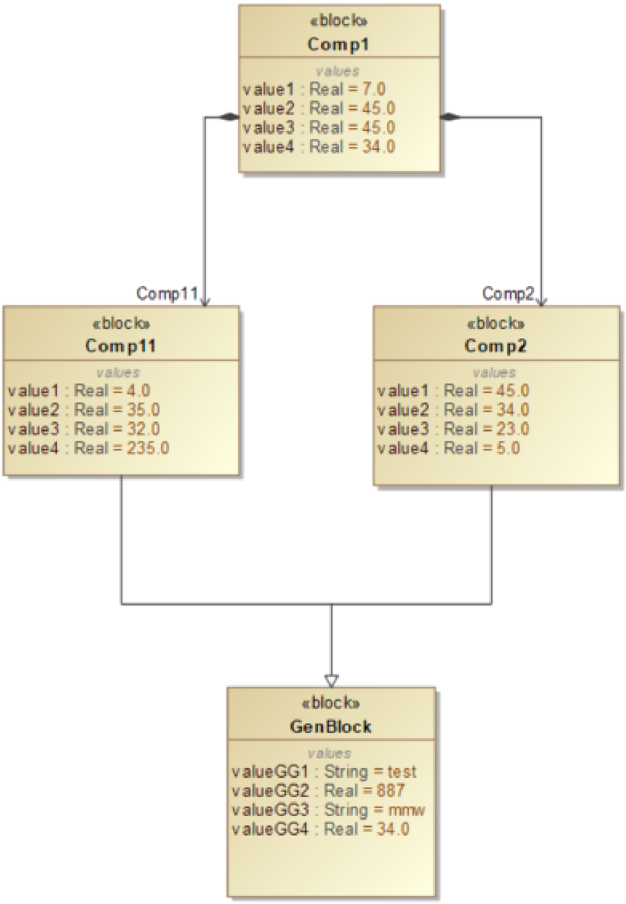
```
 key column /name as pName
 column /mse::propertyDefaultValue as pvalue
 }
}
```

4.3 getAllProperties

Description

The `getAllProperties` virtual feature retrieves properties under a block. These properties can be direct or indirect. If the block has generalization it can go as much as possible in the upper direct to get the properties but for the composition it can only go one step down.

The images below show the model, MSE file, and the view in MapleMBSE. In the model block, Comp11, and Comp2 are generalized to GenBlock using this feature MapleMBSE can query and modify the properties that are also inherited from the GenBlock.



Note: This feature can be used with the `recursivePartProperties` to get the flat view or can be used alone for the hierarchical view.

Blocks	ValueProperties	DefaultValue
Comp1	value1	7
Comp1	value2	45
Comp1	value3	45
Comp1	value4	34
Comp11	value1	4
Comp11	value2	35
Comp11	value3	32
Comp11	value4	235
Comp11	valueGG1	test
Comp11	valueGG2	887
Comp11	valueGG3	mmw
Comp11	valueGG4	34
Comp2	value1	45
Comp2	value2	34
Comp2	value3	23
Comp2	value4	5
Comp2	valueGG1	test
Comp2	valueGG2	887
Comp2	valueGG3	mmw
Comp2	valueGG4	34

Syntax

dim /mse::getAllProperties

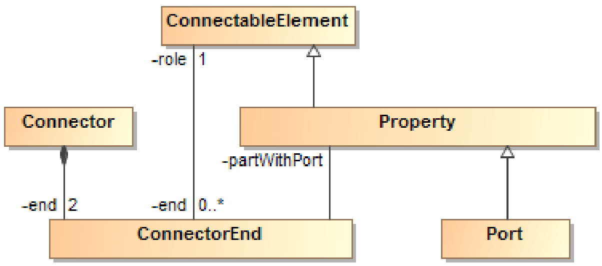
Using the getAllProperties virtual feature

1.Import the MapleMBSE ecore with an alias.
2. Create a datasource that has the blocks/classes for which you want to find the properties(for example, ../packageElement[Class]).
3. Use mse::getAllProperties[Property] to get properties from the block/Class (directly owned properties or inherit properties)
4. Create a sync-schema and synctable and after that use that datasource in the synctable.

Example

```
synctable-schema BlocksValueTable {
    dim[Class|mse::metaclassName="SysML::Blocks::Block"]{
        key column /name as BlockName
    }
    dim /mse::getAllProperties[Property
        |mse::metaclassName="MD Customization for SysML::additional_stereotypes::ValueProperty",
            aggregation="composite"] {
        key column /name as ValueProp
        column /mse::propertyDefaultValue as defaultValue
    }
}
```

5 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*).

5.1 connectedPropertyOrPort

Description

To achieve this connection MapleMBSE uses `connectedPropertyOrPort` virtual feature.
The `connectorPropertyOrPort` 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 `connectedPropertyOrProt` 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`.
4. Complete the `reference-decomposition`.

Example

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

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

synctable-schema BlocksTable {
        record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
                key column /name as BlockName
        }
        dim /ownedAttribute[Property] {
                key column /name as PropertyName
        }
}
synctable-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 5.1: connectedPropertyOrPort Example

5.2 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.
4. Complete the `reference-decomposition`.

Example

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

```
import-ecore "http://www.nomagic.com/magicdraw/UML/2.5"
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse
synctable-schema BlocksTable {
        record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
                key column /name as blockName
        }
        dim /ownedAttribute[Property] {
                key column /name as propertyName
        }
}
synctable-schema OtherConenctorEndTable(bt:BlocksTable){
        record dim[Class|mse::metaclassName="SysML::Blocks::Block"]{
                key column /name as ownerBlockName
        }

        record dim /ownedAttribute[Property]{
                key column /name as pname
        }
        record dim .mse::otherConnectorEnd[ConnectorEnd] {
                key reference-query .role @  cls
                 reference-decomposition cls = bt {
                         foreign-key column BlockName as refRoleBlock
                         foreign-key column PropertyName as refportName
                 }
                 reference-query .partWithPort @ pwp
                 reference-decomposition pwp = bt {
                         foreign-key column BlockName as refPropertyBlock
                         foreign-key column PropertyName as refPropertName
                 }
        }
}
```

Figure 5.2: otherConnectorEnd Example

6 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.,

6.1 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 assiged as client to the dependency that is being created and is used in a following dimension the class that is being querried.

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.

```
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 package = Root/packagedElement[Package|name="Package"]
data-source act = package/packagedElement[Activity]
data-source cls = package/packagedElement[Class]

synctable-schema ActivityTableSchema {
    record dim [Activity] {
        key column /name as ActName
    }
}

synctable-schema ClassAbstractionTableSchema(acts:ActivityTable) {
    record dim [Class] {
        key column /name as ActName1
    }
    record dim /mse::clientDependencies[Dependency] {
        key reference-query .supplier @ refDecomp
            reference-decomposition refDecomp = reqs {
            foreign-key column ActName as AbsName
            }
    }
}

synctable activityTableSchema = ActivityTableSchema<act>
synctable classAbstractionTableSchema = ClassAbstractionTableSchema<cls>(ActivityTable)

worksheet-template ActivityTable(cts:ActivityTableSchema){
    vertical table tab1 at (4,5) = cts{
        key field ActName : String
    }
}

worksheet-template ClassAbstractionTable(cds:ClassAbstractionTableSchema){
    vertical table tab1 at (4,5) = cds{
        key field ActName1 : String
        key field AbsName : String
    }
}
workbook{
    worksheet ActivitiesTable(ActivityTable)
    worksheet ClassAbstractionTable(classAbstractionTableSchema)
}
```

Figure 6.1: clientDependencies Example

6.2 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 assiged as supplier to the dependency that is being created and is used in a dimension following the class that is being querried.

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

Using the supplierDependencies Virtual Feature

The following example lllustrates 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 querrying the model element with mse::supplierDependencies the reference decomposition should be to a client element.

Example

```
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 package = Root/packagedElement[Package|name="Package"]
data-source cls = package/packagedElement[Class|mse::metaclassName="SysML::Requirements::Requirement"]

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

synctable-schema RequirementsDerivesTableSchema(reqs:RequirementsTable) {
    record dim [Class|mse::metaclassName="SysML::Requirements::Requirement"]    {
        key column /name as ReqName1
    }
    record dim /mse::supplierDependencies[Abstraction|mse::metaclassName="SysML::Requirements::DeriveReqt"] {
        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 tab1 at (4,5) = cts{
        key field Name : String
    }
}

worksheet-template ReqClassDependency(cds:RequirementsDerivesTableSchema){
    vertical table tab1 at (4,5) = cds{
        key field Name1 : String
        key field DeriveName : String
    }
}

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

Figure 6.2: supplierDependencies Example

7 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)

7.1 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 `enumrationName` virtual feature is as follows:
`alias::enumrationName="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 `enumrationName` virtual feature must be used while querying an *Element* with a *Stereotype* that supports some *Property* with an *Enumeration* `type.` For more information on 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 `enumrationName`.

Using the enumerationName 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

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

workbook {
    worksheet EnumrationTemplate(enums)
}

data-source Root[Model]
data-source reqs = Root/packagedElement[Package|name="Enum"]
        /packagedElement[Class|mse::metaclassName="SysML::Non-Normative Extensions::Requirement::extendedRequirement"]

synctable-schema EnumSchema {
    dim [Class|mse::metaclassName="SysML::Non-Normative Extensions::Requirement::extendedRequirement"] {
        key column /name as rName
        column /appliedStereotypeInstance[InstanceSpecification]
            /slot[Slot|mse::featureName="SysML::Non-Normative Extensions::Requirement::extendedRequirement::verifyMethod"]
            /value[InstanceValue|mse::enumerationName="SysML::Non-Normative Extensions::Requirement::VerificationMethodKind"]
            /mse::enumerationLabel as verificationMethod
    }
}

synctable enums = EnumSchema<reqs>

worksheet-template EnumrationTemplate (es: EnumSchema) {
    vertical table tab1 at (1, 1) = es {
        key field rName
        field verificationMethod
    }
}
```

7.2 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 supports some *Property* with a *Enumeration* `type` and which was

filtered with `enumerationName.` For more information how to access this kind of *InstanceValue*, see the previous section.

8 Util

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

8.1 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 ecore.

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 ecore, 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 mse

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 8.1: multiplicityProperty Example

9 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 two distinct virtual features.

9.1 ActivityControlFlow

Description

A *ControlFlow* is an *ActivityEdge* that is used to control the execution of *ActivityNodes* within an Activity.

In MapleMBSE, the virtual feature ActivityNode is used as a reference to create ControlFlows. Note that in MapleMBSE, abstract classes such as ActivityNode cannot be instantiated. Thus, you must instantiate concrete classes such as CallActionBehavior, ActivityParameterNode, or InitialNode. *S*ee 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 *Importing the MapleMBSE Ecore (page 3)*.

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 a schema that navigates until an *ActivityNode* or an element that has an ActivityNode as its first dimension
3. Make a dimension `reference-query` to another *ActivityNode* using `.mse::activityControlFlow.`
4. Complete the `reference-decomposition`.

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

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

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

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

worksheet-template CallBehaviorActionTemplate (cbasc: CallBehaviorActionSchema) {
    vertical table tab1 at (2, 1) = cbasc {
        key field nName
    }
}

synctable-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 9.1: ActivityControlFlow Example

9.2 ActivityObjectFlow

Description

An *ObjectFlow* is an *ActivityEdge* that represents the flow of object data between *ActivityNodes* within an *Activity*. Sometimes, the *ObjectFlow* directly connects two *ActivityNodes*. However, due to UML specifications, some *ActivityNodes* cannot be connected directly using an *ObjectFlow*. In these cases *Pins* are required. *Pins* are objects that accept and provide values to actions. These values represent an input to an action or output from an action.

If an *ActivityNode* that requires *Pins*, such as *CallBehaviorAction*, also has a *Behavior* that further describes it's functionality, then both the *ActivityNode* and *Behavior* need to have their *Pins* (specifically *ActivityParameterNode* and *Parameters*) synchronized, both in quantity and direction.

Syntax

The general syntax for using the `activityObjectFlow` virtual feature is as follows:
`.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 until an *ActivityNode* or an element which has an ActivityNode as its dimension.
3. Make a dimension `reference-query` to another *ActivityNode* using `.mse:: activityObjectFlow`.
4. Complete the reference-decomposition.

Example

```
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 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 9.2: ActivityObjectFlow Example

10 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.

10.1 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.
4. Complete the reference-decomposition.

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

```
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 pkg = Root/packagedElement[Package|name="statemachine"]
data-source stm = pkg/packagedElement[StateMachine|name="stm"]
data-source rg = stm/region[Region|name="rg"]
data-source vertexes = rg/subvertex[Vertex]
data-source states = rg/subvertex[State]

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

synctable-schema StateSchema {
    dim [State] {
        key column /name as sName
    }
}

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

synctable-schema Schema(vsc: VertexSchema) {
    dim [Vertex] {
        key column /name as vName
    }

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

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

synctable vertexTable = VertexSchema<vertexes>
synctable stateTable = StateSchema<states>
synctable transitionTable = Schema<vertexes>(vertexTable)

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

Figure 10.1: VertexTransition Example

11 Comments

11.1 ownedComments

Description

A comment is an element that represents a textual annotation that can be attached to other elements or a set of elements.
A comment can be owned by any element.
This virtual feature creates a comment and annotated it with the owner element.

Syntax

The general syntax for using the ownedComments virtual feature is as follows:
`/alias:: ownedComments`
Where the alias is the alias you assigned to the MapleMBSE ecore.

Using the ownedComments Virtual Feature

The following example shows you how to use the ownedComments feature.

1. Import the MapleMBSE ecore, as usual the alias used is `mse`
2. Inside a syntable-schema navigate to a *Class*
3. Within that dimension, define a regular column using `/mse::ownedComments[Comment]`
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 mse

data-source Root[Model]
data-source blocks = Root/packagedElement[Package]

synctable-schema Schema {
    record  dim [Package] {
        key column /name as packageName
    }

    record dim /packagedElement[Class] {
        key column /name as className
        column /mse::ownedComments[Comment]/body as body
    }
}

worksheet-template Template(ts: Schema) {
    vertical table t at (1,1) = ts {
        key field packageName
        field className
        field body :String
        sort-keys packageName
    }
}

synctable-schema Schema2 {
    record  dim [Package] {
        key column /name as packageName
    }

    record dim /packagedElement[Class] {
        key column /name as className
    }

    record dim /mse::ownedComments[Comment] {
        key column /body as body
    }
}

worksheet-template Template2(ts: Schema2) {
    vertical table t at (1,1) = ts {
        key field packageName
        field className
        field body :String
        sort-keys packageName
    }
}

synctable Table1 = Schema<blocks>
synctable Table2 = Schema2<blocks>

workbook {
    worksheet Template(Table1)
    worksheet Template2(Table2)
}
```

12 Slots

SysML permits users to create an instance of the classifiers with their properties. If the classifier is defined with some properties, the instances will own slots that contain the properties defined. This instance allows users to create concrete elements from the more general model. In order to simplify the task related to InstanceSpecification, MapleMBSE proposes the following virtual features to support the creation, edition, and removal of instances and their Slots.

12.1 SlotValue

Description

SysML has a complex structure to access the values within Slots. Those values change widely depending on the type of the property defining the owing Slot. Imagine a real property defining Slot, which, in order to contain that value, requires a LiteralReal, and then the real value will be stored within that literal. Each type has its own literal class, and for reference to other instances the mechanisms are another matter altogether. This is just a reminder of how much complexity this InstanceSpecification modeling has, but thanks to this virtual feature, MapleMBSE simplifies and hides that complexity. Using a single access point and without caring about the concrete type of the property, SlotValue will return a string representing the value given Slot. MapleMBSE proposes an easy mechanism to display, create, and edit that first value associated to any Slot. Emphasis in first, SysML metamodel allows to associate several values to a single Slot, it is by design that MapleMBSE does not use this virtual feature for a different multiplicity.

Syntax

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

```
column [Slot]/alias::slotValue as column_name
```

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 slotValue virtual feature must be used while querying a Slot, and the return string can only be used within a column.

Using the SlotValue Virtual Feature

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

1. Import the MapleMBSE ecore with an alias
2. Create a schema that has a dimension accessing a Slot from an InstanceSpecification, see line 24.
3. Make sure that you are using the right combination of applied Classifier to the InstanceSpecification and the Slot's definingFeature.
4. Access that Slot's value using the slotValue virtual feature, see line 30

Example

```
import-ecore "http://www.nomagic.com/magicdraw/UML/2.5.1"
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source pkg = Root/packagedElement[Package|name="Slots"]
data-source blocks =  pkg/packagedElement[Class|mse::metaclassName="SysML::Blocks::Block"]
data-source instances = pkg/packagedElement[InstanceSpecification]

synctable-schema PropertySchema {
          record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
                            key column /name as bName
                                      }
                            dim /ownedAttribute[Property] {
                                key column /name as pName
                                          }
}

synctable-schema Schema*(psc: PropertySchema){
          record dim [InstanceSpecification] {
                  key column /name as iName
                        }
                        dim /slot[Slot] {
                         key reference-query .definingFeature @pRef
                         reference-decomposition pRef = psc {
                             foreign-key column bName as bName
                             foreign-key column pName as pName
                               }
                               column /mse::slotValue as value
                            }
}

worksheet-template Template(sc: Schema) {
          vertical table tab1 at*(2, 1) = sc {
                 key field iName
                 key field bName
                 key field pName
                 field value
                 sort-keys iName, bName, pName
                 }
}

synctable propertyTable = PropertySchema<blocks>
synctable syncTable = Schema<instances>(propertyTable)

workbook {
worksheet Template(syncTable)
  }
```

12.2 InstanceTree

Description

SysML forces each Slot to be owned by an InstanceSpecification. The regular way to navigate would be from InstanceSpecification to Slot, and without any other mechanisms it would be hard get a list of the InstanceSpecification tree for a given Slot. Remember that a Slot can have, as values, references to other InstanceSpecifications, and those would be part of tree for that given Slot. Returning this special tree list of InstanceSpecifications is the goal of instanceTree virtual feature.

Syntax

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

```
dim .alias::instanceTree[InstanceSpecification]
```

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 instanceTree virtual feature must be used in a dimension level after querying a Slot, the return type is a list of reference to the InstanceSpecifications which belong to the tree of the queried Slot.

Using the InstanceTree Virtual Feature

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

1. Import the MapleMBSE ecore with an alias
2. Create a schema that has a dimension accessing a Slot from an InstanceSpecification, see line 24.
3. The dimension after the Slot one should use the instanceTree, see line 32

Example

```
import-ecore "http://www.nomagic.com/magicdraw/UML/2.5.1"
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source pkg = Root/packagedElement[Package|name="Slots"]
data-source blocks =  pkg/packagedElement[Class|mse::metaclassName="SysML::Blocks::Block"]
data-source instances = pkg/packagedElement[InstanceSpecification]

synctable-schema PropertySchema {
    record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
        key column /name as bName
    }

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

synctable-schema Schema (psc: PropertySchema){
    record dim [InstanceSpecification] {
        key column /name as iName
    }

    record dim /slot[Slot] {
        key reference-query .definingFeature @pRef
        reference-decomposition pRef = psc {
            foreign-key column bName as bName
            foreign-key column pName as pName
        }
    }

    dim .mse::instanceTree[InstanceSpecification] {
        key column /name as iNameTree
    }
}

worksheet-template Template(sc: Schema) {
    vertical table tab1 at (2, 1) = sc {
        key field iName
        key field bName
        key field pName
        key field iNameTree
        sort-keys iName, bName, pName
    }
}

synctable propertyTable = PropertySchema<blocks>
synctable syncTable = Schema<instances>(propertyTable)

workbook {
    worksheet Template(syncTable)
}
```

12.3 InstanceWithSlots

Description

It is well known that InstanceSpecifications and their Slots are an essential part of a useful and meaningful model. They are necessary to achieve results, but the task of instantiating, editing, and removing those elements is slow and error prone. MapleMBSE helps to create very complex structures using InstanceWithSlots, when you pass Class as parameter to an InstanceSpecification using this virtual feature, you will see how:

- MapleMBSE updates the list of classifiers that are applied to a given InstanceSpecification
- For each defining property related to that applied class, MapleMBSE will create a Slot defined by a property with its default value.

Syntax

To use instanceWithSlots virtual feature as a column within an InstanceSpecification dimension, the syntax is as follows:

```
reference-query .alias::instanceWithSlots @reference_name
```

This configuration line needs to be completed with a reference-decomposition that uses a Class schema, see the example for further information. Also remember that alias is the alias you assigned to the MapleMBSE ecore.

For more information on assigning aliases, see *Importing the MapleMBSE Ecore (page 3)*.

Using the InstanceWithSlots Virtual Feature

The following example illustrates one way to use the instanceWithSlots virtual feature:

1. Import the MapleMBSE ecore with an alias
2. Create a schema that has a dimension accessing an InstanceSpecification, see line 16.
3. Reference-query instanceWithSlots, see lines 18/19

Example

```
import-ecore "http://www.nomagic.com/magicdraw/UML/2.5.1"
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source pkg = Root/packagedElement[Package|name="Slots"]
data-source blocks =  pkg/packagedElement[Class|mse::metaclassName="SysML::Blocks::Block"]
data-source instances = pkg/packagedElement[InstanceSpecification]

synctable-schema BlockSchema {
    record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
        key column /name as bName
    }
}

synctable-schema Schema (bsc: BlockSchema){
    record dim [InstanceSpecification] {
        key column /name as iName
        reference-query .mse::instanceWithSlots @ bRef
        reference-decomposition bRef = bsc {
            foreign-key column bName as cName
        }
    }
}

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

synctable blockTable = BlockSchema<blocks>
synctable syncTable = Schema<instances>(blockTable)

workbook {
    worksheet Template(syncTable)
}
```

12.4 RecursiveInstanceWithSlots

Description

The RecursiveInstanceWithSlots virtual feature does the same thing that InstanceWithSlots does but for all possible InstanceSpecifications in the tree. If a Class A is composed by other Class B and you use recursiveInstanceWithSlots to create an InstanceSpecification of Class A, MapleMBSE will also create an InstanceSpecification for Class B with Slots.

Syntax

To use recursiveInstanceWithSlots virtual feature as a column within an InstanceSpecification dimension, the syntax is as follows:

```
reference-query .alias::recursiveInstanceWithSlots @refer-
ence_name
```

This configuration line needs to be completed with a reference-decomposition that uses a Class schema, see the example for further information. Also remember that alias is the alias you assigned to the MapleMBSE ecore. For more information on assigning aliases, see *Importing the MapleMBSE Ecore (page 3)*.

Using the RecursiveInstanceWithSlots Virtual Feature

The following example illustrates one way to use the recursiveInstanceWithSlots virtual feature:

1. Import the MapleMBSE ecore with an alias
2. Create a schema that has a dimension accessing an InstanceSpecification, see line 16.
3. Reference-query recursiveInstanceWithSlots, see lines 18/19

Example

```
import-ecore "http://www.nomagic.com/magicdraw/UML/2.5.1"
import-ecore "http://maplembse.maplesoft.com/common/1.0" as mse

data-source Root[Model]
data-source pkg = Root/packagedElement[Package|name="Slots"]
data-source blocks =  pkg/packagedElement[Class|mse::metaclassName="SysML::Blocks::Block"]
data-source instances = pkg/packagedElement[InstanceSpecification]

synctable-schema BlockSchema {
    record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
        key column /name as bName
    }
}

synctable-schema Schema (bsc: BlockSchema){
    record dim [InstanceSpecification] {
        key column /name as iName
        reference-query .mse::recursiveInstanceWithSlots @ bRef
        reference-decomposition bRef = bsc {
            foreign-key column bName as cName
        }
    }
}

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

synctable blockTable = BlockSchema<blocks>
synctable syncTable = Schema<instances>(blockTable)

workbook {
    worksheet Template(syncTable)
}
```

12.5 AttachedFile

Description

The attachedFile virtual feature supports MagicDraw file attachments, which are accessible through comments. It downloads all the relevant file attachments, and displays hyperlinks to temporary locations in the user interface. When the user clicks on the link, the user interface will open the file.

Syntax

The syntax to use attachedFile is as follows:

```
column /mse::attachedFile as fileName
```

Using the attachedFile Virtual Feature

The following example illustrates one way to use the recursiveInstanceWithSlots virtual feature:

1. Import the MapleMBSE ecore with an alias
2. Create a schema that has a dimension accessing an ownedComment line 5, in the column level call the attached VF see line 6 in the example code

Example

```
synctable-schema AttachedFileSchema {
record dim[Package]{
key column /name as PkgName
}
dim /ownedComment[Comment|mse::stereotypeNames="UML Standard
Profile::MagicDraw Profile::AttachedFile"]{
column /mse::attachedFile as fileName
}
}
```

12.6 Slots

Description

Use the slots virtual feature to add a new slot and display all the slots recursively under a top-level instance. The slots virtual feature can also be used to delete a child slot under a top level instance and then recreate the child slot.

Syntax

The syntax to use slots is as follows:
`dim /mse::slots[Slot]`

Using the slots Virtual Feature

The following example illustrates one way to use the Slots virtual feature:

1. Import the MapleMBSE ecore with an alias
2. Create a schema that has a dimension accessing slots using the slots virtual feature (shown in line 6 in the slots VF get all the slots Recursively under a instance specification

Example

```
synctable-schema InstanceTable(blk : BlocksTable){
record dim [InstanceSpecification] {
key column /name as instanceName
}

dim /mse::slots[Slot] {
key reference-query .definingFeature[Property] @ dfRef
reference-decomposition dfRef = blk {
foreign-key column bName as bName
foreign-key column valName as valName
}
key column /mse::slotValue as cValue
}
}
```

13 Recursivity

13.1 getRecursively

Description

The getRecursively virtual feature works as a chained data source, traversing all subelements recursively under the owner data source or QPE and then filters out elements matching the qualifier and filter.

Note: This virtual feature only works for packaged elements.

Syntax

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

```
data-source packages = Root/packagedElement[Pack-
age|name="C3"]/getRecursively[Package]
```

Where C3 is the name of the package. All packages under C3 will be retrieved.

```
data-source packages = Root/packagedElement[Package]/getRe-
cursively[Package]
```

In the above data source syntax example, all the packages under root are retrieved. After that, all the elements (packages) under those packages are retrieved, recursively. When you are adding a new element, in this case, it will go under one of the packages which was retrieved from the root.

Note: This feature only works with elements supporting the packageElement feature.

```
data-source packagesC3Class = Root/mse::getRecursively[Pack-
age|name="C3"]/packagedElement[Class]
```

In the syntax example above, first, getRecursively finds the packages under the model. The model may have more than one C3 package. After you have all the packages then you display classes under those packages only, not recursively.

Note that this is maybe very inefficient when the model is big, and it would be much faster to explicitly specify the path for each existing C3 package.

```
data-source packagesC3Class = Root/mse::getRecursively[Pack-
age|name="C3"]/ mse::getRecursively[Class]
```

This data source gets all packages recursively and then sorts them and shows the ones named

C3. After that, you get all classes under these C3 packages and any of their subpackages.

Using the getRecursively Virtual Feature

The following example shows you how to use the ownedComments feature.

1. Import the MapleMBSE ecore, as usual the alias used is `mse`
2. Inside a syntable-schema navigate to a *Package*
3. In the next dimension, use `/mse::getRecursively[Class]` to get all the class under the top package(Previous dim/root dim) and sub packages
4. Complete the rest of the configuration as usual: `worksheet-templates`, `synctable` and `workbook`

Example

In this example, the code snippet retrieves all the packages and sub packages under the package C3

```
synctable-schema PackageTable {
    record dim [Package] {
        key column /name as pName
    }
    record dim / mse:: getRecursively[Class] {
       key column /name as cName
   }
}
```

This feature can be used anywhere in a QPE or data source, but not at the start of QPE or data source.

```
synctable-schema PackageTable {
    record dim [Package] {
        key column /name as Name
    }
    record dim / mse:: getRecursively[Package] {
       key column /name as Name1
   }
}
```

14 Constraints

SysML makes it hard to accessing the minimum and maximum constraint data in SysML can be difficult because the model is forced to use LiteralString and other elements (e.g. TimeExpression, Constraints). The main purpose of the virtual feature in this chapter is to allow the MSE file to access this data with ease and aggregate it into simple double period notation (..). Another benefit to the use of a virtual feature for working with constraint data is that the end user has fewer inputs to provide, reducing human error.

14.1 durationConstraint

Description

To display and set duration constraints, MapleMBSE provides a virtual feature that allows the simultaneous creation and editing of the min and max limits of the constraint using a simple double dot notation (for example, minConstraint..maxConstraint). In the case of both minConstraint and maxConstraint representing numerical values (in decimal or scientific notation), MapleMBSE performs a check to determine if the minConstraint value is less than or equal to the maxConstraint value.

Syntax

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

```
column /mse::durationConstraint as dcValue
```

For user input, the durationConstraint virtual feature accepts numerical values as well as arbitrary string values.These values are joined by double periods (..). In addition, you can use an escape character (\) to include periods as part of the minimum and maximum constraint values.

	A	B
1	Constraint Name	Value
2	Minor	0..18
3	Voter	18..99
4	TimeConfTx	10..60
5	Temp	cold..hot

The table below gives specific examples of both valid and invalid syntax for use of double periods.

User Input Example	Minimum Constraint Value	Maxim Constraint Value	Comment
`2..3.5`	`2`	`3.5`	Valid
`-1..3.2`	`-1`	`2.3`	Valid
`5.5..2`	`5.5`	`2`	Invalid. The upper bound is less than lower bound
`2.3 .. 2.3`	`2.3`	`2.3`	Valid. Numerical values are trimmed, and both bounds are allowed to be equal
`1….3`	`1`	`..3`	Valid. First double dot is taken as the separator
`abc..foo bar`	`abc`	`foo bar`	Valid. String values can contain spaces
`1.3`			Invalid. No double period present
`..`			Valid. Empty Min/Max is allowed
`min..`	`min`		Valid. Empty max
`..max`		`max`	Valid. Empty min
`escape\....dots`	`escape.`	`.dots`	Valid. Escaping first period
`invalid\..input`			Invalid. No double period present
`2 . 5 .. 2.4`	`2 .5`	`2.4`	Valid. The min is not a valid number because of the space.

Using the durationConstraint Virtual Feature

The following example shows you how to use the `durationConstraint` feature.

1. Import the MapleMBSE ecore, as usual the alias used is `mse`.
2. Inside a syntable-schema navigate to a `DurationConstraint`, in this case `/ownedRule[DurationConstraint]` within an Activity.
3. Within that dimension, define a regular column using `/mse::durationConstraint`.
4. Complete the rest of the configuration as usual: `worksheet-templates`, `synctable` and `workbook`.

Example

```
synctable-schema Schema {
 record dim [Activity] {
```

```
  key column /name as aName
 }
 record dim /ownedRule[DurationConstraint] {
  key column /name as dcName
  column /mse::durationConstraint as dcValue
 }
}
```

15 Generalization

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

15.1 specificClass

Description

The `specificClass` virtual feature provides a simple, more direct way of creating generalizations between a more generalized element and a more specialized element. The `specificClass` virtual feature also sets the values for the specific and general elements and then stores the generalization relationship information in the specific class.

Syntax

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

```
.mse::specificClass
```

Using the specificClass Virtual Feature

The following example illustrates one way to use the `specificClass` virtual feature:

1. Import the MapleMBSE ecore with an alias
2. Create a datasource which query the Blocks from the model ”`../PackageElement-Class|mse::metaclassName="SysML::Blocks::Block"]`”
3. In the synctable schema start from the gerneralized block
4. For the next dimension, use the virtual feature which uses the reference decomposition to create the gereneralization between the generalized block and the specific block

Example

```
synctable-schema BlockpropertiesTable(blocks: BlocksTable){
 record dim [Class|mse::metaclassName="SysML::Blocks::Block"] {
  key column /name as generalClassName
 }
 record dim .mse::specificClass[Class] @genname{
  reference-decomposition genname = blocks{
   foreign-key column BlockName as specificClassName
  }
```

```
  }
}
```

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