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Composer

Kitalpha

PolarSys

OPEN

Version 1.0.0

THALES

Agenda

1 **Introduction**

2 **Composer**

What is Composer?
Principles

3 **Example**

Agenda

1 Introduction

2 Composer

What is Composer?
Principles

3 Example

Purpose

Context

Code generation technologies are:

- Not flexible
- No control on the organization of generated files
- No way to adapt the generated code to specific libraries
- Not very customizable
- Mix of templates and code (i.e. templates are integrated in code of generation algorithms and vice versa)

Purpose

- Design a tool to overcome the limitations of code generation technologies by assembling, adapting and extending code generators
- The tool is not a code generator itself but based on existing one
- Easily customizable
- Separation of templates and algorithms

Agenda

1 Introduction

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What is Composer?

Principles

3 Example

Composer

Features

Composer is an Eclipse component that allows to:

- Organize the generated files
- Be independent of generation technology
- Separate templates and algorithms

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1 **Introduction**

2 **Composer**

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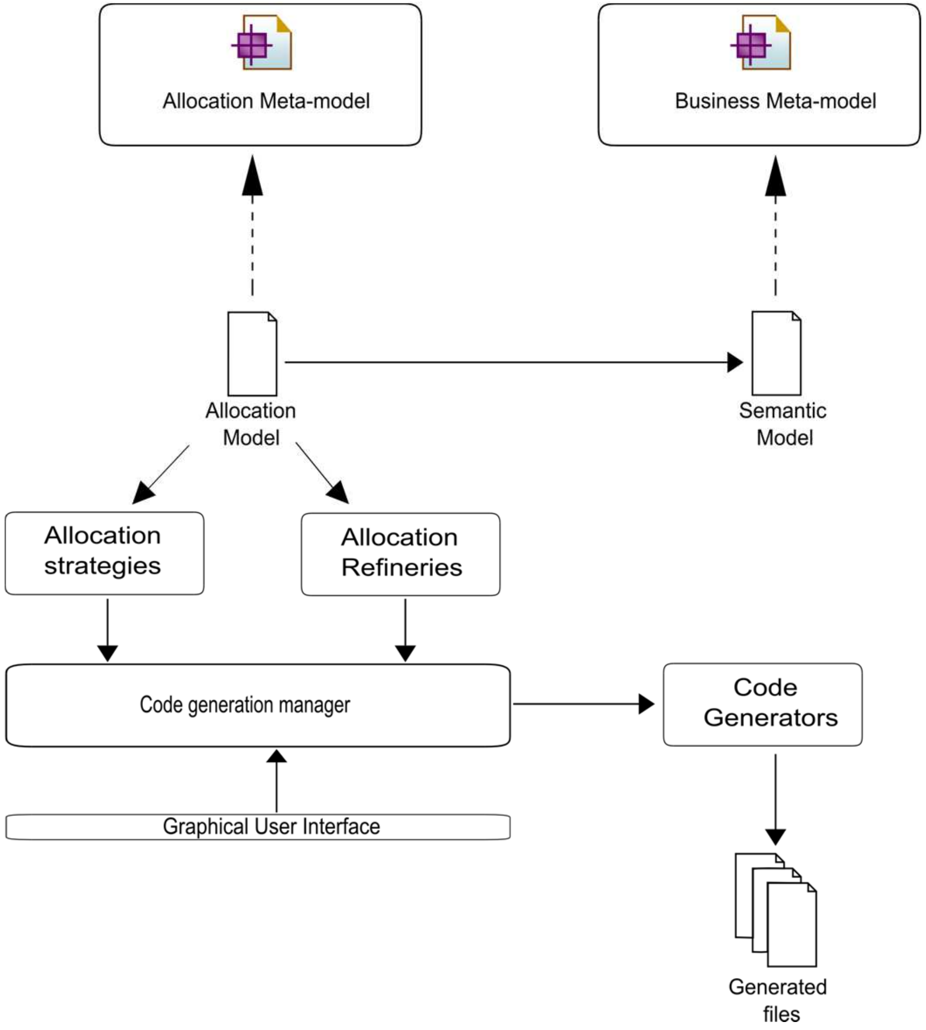
Principles

3 **Example**

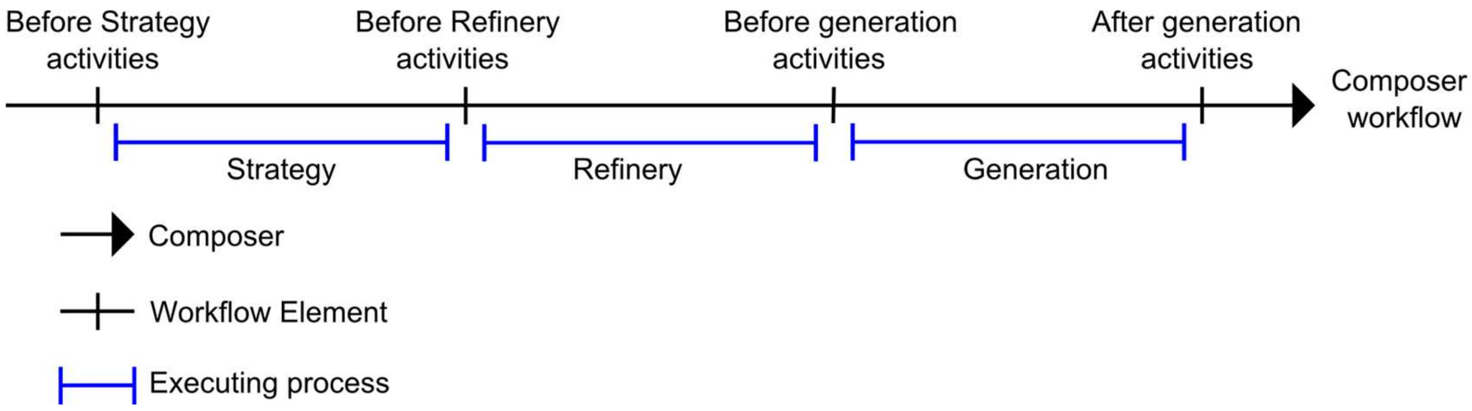
Principles



Big picture: Software architecture with Composer

Composer workflow

- **Generation strategies**: definition of one or more strategies to code generation
- **Generation refineries**: definition for each strategy a refinery that computes strategy properties
- **Generators**: register the generators and launch them
- **Additional Cadence activities** may be executed at Composer workflow element

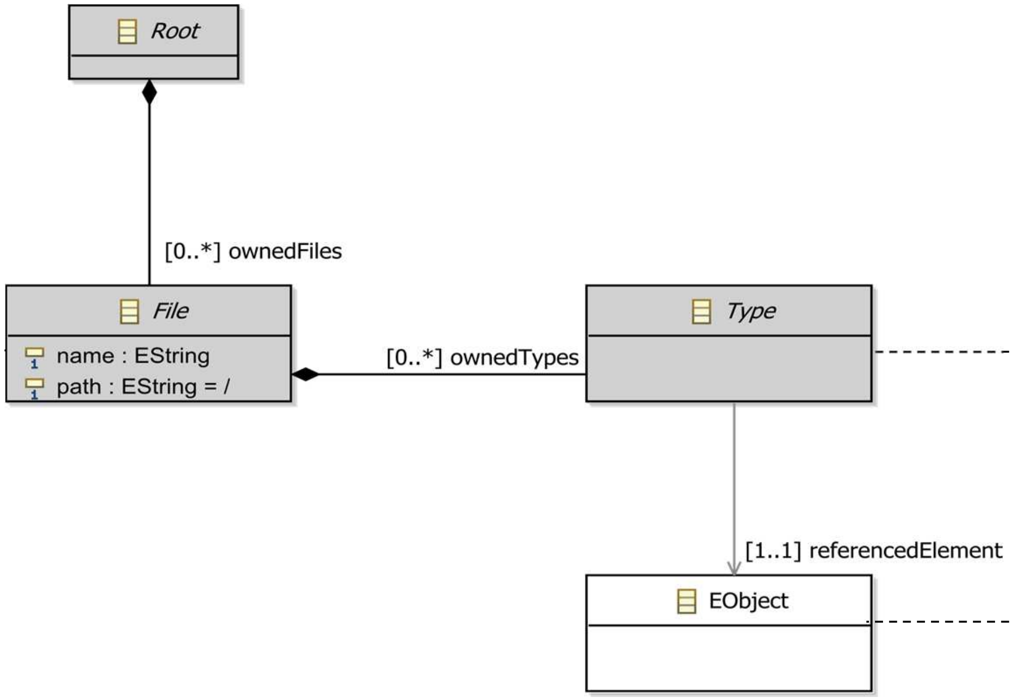

Before Strategy activities
Before Refinery activities
Before generation activities
After generation activities
Composer workflow
Strategy
Refinery
Generation
Composer
Workflow Element
Executing process

Principles – Strategy – 1/4

Strategy concepts

Allocation Concept

- Generic and extensible meta-model to define a “generation plan”
- Defines the files and their structure
- Each file of allocation model is bound to one or more elements of the semantic model (types)
- All entities of allocation metamodel are abstract



The file that will be generated

The type to be included in the file

Reference to the semantic model element

Principles – Strategy – 2/4

Binding Concept

- Links the allocation meta-model to the semantic model
- Declaration of binding
  - Contribute to extension point : org.polarsys.kitalpha.cgm.allocation.binding
  - Provide:
    - Name : binding name [Required]
    - Id : binding identifier [Required]
    - NsUri : NSURI of the allocation metamodel [Required]
    - Description : binding description [Required]

  - Bind all the NsUri of the metamodels which the business model is conform to the allocation metamodel
    - NsUri : The NsUri of the metamodel to bind [required]

Principles – Strategy – 3/4

Strategy

- Creates the allocation model from a semantic model or a set of model elements
- Returns the Root of the allocation
- Implements IStrategy contract

Strategy declaration

- Contribute to extension point : org.polarsys.kitalpha.cgm.allocation.strategies
- Provide:

▪ Name	: strategy name	[Required]
▪ NsUri	: NSURI of the allocation metamodel	[Required]
▪ Id	: strategy identifier	[Required]
▪ Class	: class that implements IStrategy	[Required]
▪ Description	: description of the strategy	[Optional]

Principles – Strategy – 4/4

IStrategy contract

- Contract used to specify how the allocation model is created

The contract

- Strategy parameters:
  - Are used to customize, to adapt the strategy by the user
  - getParameters(): Creates a map of parameters and return it.
- Parameter validation:
  - To validate Strategy parameters
  - validateParameters(Map of parameters): Validate the parameters of the strategy. Returns the Map of the invalid parameters
- Allocation model:
  - Creation of the allocation model
  - allocateModelElements(SemanticModelRoot, Map of parameters): returns the root of allocation model created from the semantic model root)
  - allocateModelElements(SemanticModelRoot, Map of parameters, List of semantic model elements): return the root of allocation model created from the list of semantic model elements

Principles – Refinery – 1/3

Refinery concepts

Allocation Concept

- Works on allocation model and semantic model
- Satisfies the constraints of the generation
  - Reorder the elements in one file
  - Identify the dependencies (imports, includes declarations)
- Computes and fills the specific properties of allocation model from the allocation model and the semantic model
- Implements IRefinery contract

⚠ Whereas we can define several strategies, we must define only one refinery per generated language

Principles – Refinery – 2/3

Refinery Declaration

- Contribute to extension point : org.polarsys.kitalpha.cgm.allocation.rafineries
- Provide:

Name	: the name of the refinery	[Required]
NsUri	: NSURI of the allocation metamodel	[Required]
Id	: refinery identifier	[Required]
Class	: class that implements IRefinery	[Required]
Description	: description of the refinery	[Optional]

Principles – Refinery – 3/3

IRefinery contract

- Contract used to fills the specific properties of allocation model

The contract

- Refinery parameters:
  - Used to to customize, to adapt the refinery by the user
  - getParameters(): Returns a map of the Refinery parameters
- Parameter validation:
  - To validate Refinery parameters
  - validateParameters(Map of parameters): Validate the parameters of the Refinery. Returns the Map of the invalid parameters.
- Refinery job
  - To compute all specific properties of allocation model.
  - refineModelElements(Allocation model root, Refinery parameters): Fill the allocation model with the specific target language and returns the root of allocation

Principles – Generation – 1/2

Generation concepts

Generator

- Delegates the generation to any other code generation technologies
- Launch the generator
- The generation is based on information contained in the allocation model
- Implements the IGenerator contract

Generator declaration

- Contribute to extension point: org.polarsys.kitalpha.cgm.cots.generators
- Provide:

Name	: generator name	[Required]
NsUri	: NSURI of the allocation metamodel	[Required]
Id	: unique identifier of the generator	[Required]
Class	: class that launches the generation	[Required]
Description	: description of the generator	[Optional]

Principles – Generation – 2/2

IGenerator contract

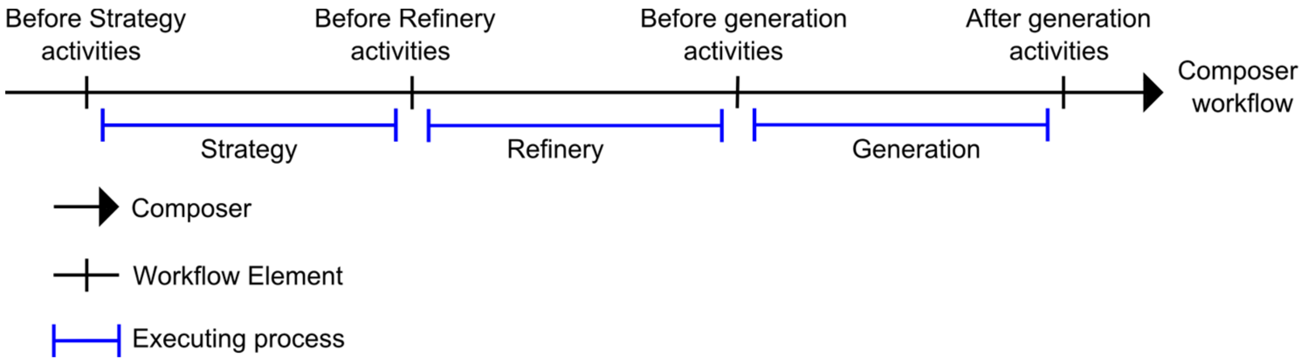
- Used to launch the code generator

The contract

- Generator parameters
  - Used to customize, to adapt the generator by the user
  - getParameters(): Returns a map of the generator parameters
- Parameter validation
  - To validate Generator parameters
  - validateParameters(Map of parameters): Validate the parameters of the strategy. Returns the Map of the invalid parameters
- Generator
  - The start of the generator
  - generateCode(Allocation root model, generator parameters, output folder): Generates the allocation model in the output folder

Principles

Composer Activities


Before Strategy activities
Before Refinery activities
Before generation activities
After generation activities
Composer workflow
Strategy
Refinery
Generation
Composer
Workflow Element
Executing process

- Composer workflow is based on cadence
  - Declares four workflow elements:
    - **Before strategy**: Activities can be executed before strategy process (e.g., Validation of semantic model, adapt a semantic model)
    - **Before refinery**: Activities can be executed before the refinery process (e.g., Validation of allocation model)
    - **Before generation**: Activities can be executed before the generation task (e.g., clean the output directory)
    - **After generation**: Activities can be executed after the generation task (e.g., format of the code, Commit the code on SVN, compile the code)

Principles

Libraries

- Are allocation models
- Used to resolve the dependencies of the generated code if this one uses external code (e.g., includes)
- Implements ISearchAlgorithm contract
  - To get the path of an EObject in the allocation model
  - public String getIncludeFromAllocationModel(Root root, EObject object)
    - The method to implement
    - Computes the path of the object in the generated file and returns it
    - Returns null if the object is not found

Principles – Java API – 1/2

Composer launch API – semantic model

- Composer can be launched on:

  A part of semantic model: list of elements from a semantic model
  One semantic model : resource contains the semantic model
  Many semantic models : resource set contains the semantic models

- Method

```
public void launch(
    final IStrategy strategy,                        //the strategy used for the generation
    final Map<String, Parameter> strategy_p,         //the strategy parameters
    final IRefinery refinery,                                  //the refinery used for the
    generation
    final Map<String, Parameter> refinery_p,         //the refinery parameters
    final IGenerator generator,                      //the generator used for the generation
    IPath path,                                      //the output folder
    final Map<String, Parameter> generator_p         //the generator parameters
    The semantic model,                              //the semantic model
    Boolean save                                     //for saving the allocation model
);
```

- The semantic model

  List<EObject> partOfModel | Resource model | ResourceSet models

Principles – Java API – 2/2

Composer registry API

- The registry stores
  - Strategies
  - Refineries
  - Generators

- Queries on the registry
  - Get a strategy with its name or its ID
  - Get a refinery with its name or its ID
  - Get a generator with its name or its ID

Principles

Path variables

- $modelDir
  - Refer the directory where the semantic model is located
  - Can be used to generate the generation plan in the model directory (or in sub-directory: $model/my_generation)
- $projectDir
  - Refer the project where the semantic model is located
  - Can be used to generate the generation plan in the same directory project than the semantic model (ex: $projectDir/my_generation)
- Contribute with a new variable
  - Define the variable by implementing IComposerVariable contract
    - getName() method: returns the name of the variable (ex: modelDir)
    - execute(Object) method: Operation on the path when the variable is found and returns the path
  - Add the variable in the registry
    - ComposerVariableInterpreter.INSTANCE.addNewVariable(VariableImpl);

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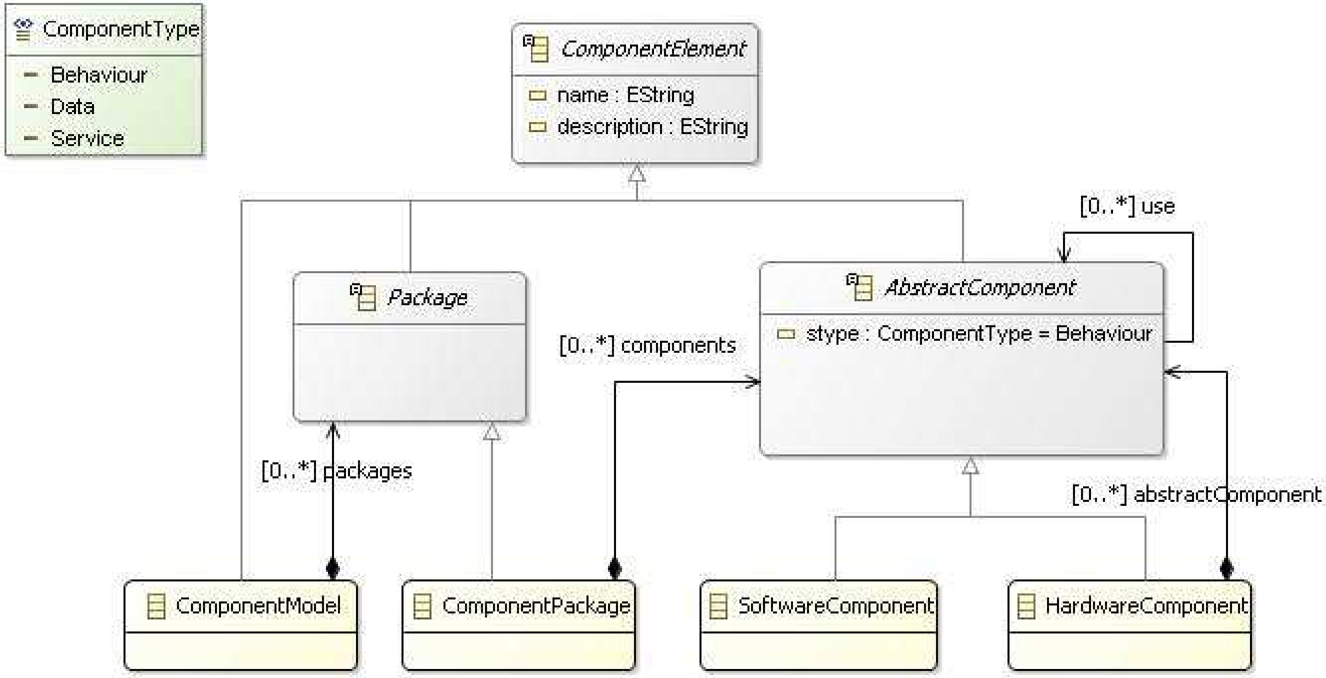
Example



ComponentSample Metamodel

Example

Use Case #1

- **Generate Multi Files HTML Documentation**
  - Strategy one (Multi File Strategy)
    - For each component (Hardware, Software) create one HTML Page
    - Create index page which contains links to the component

Use Case #2

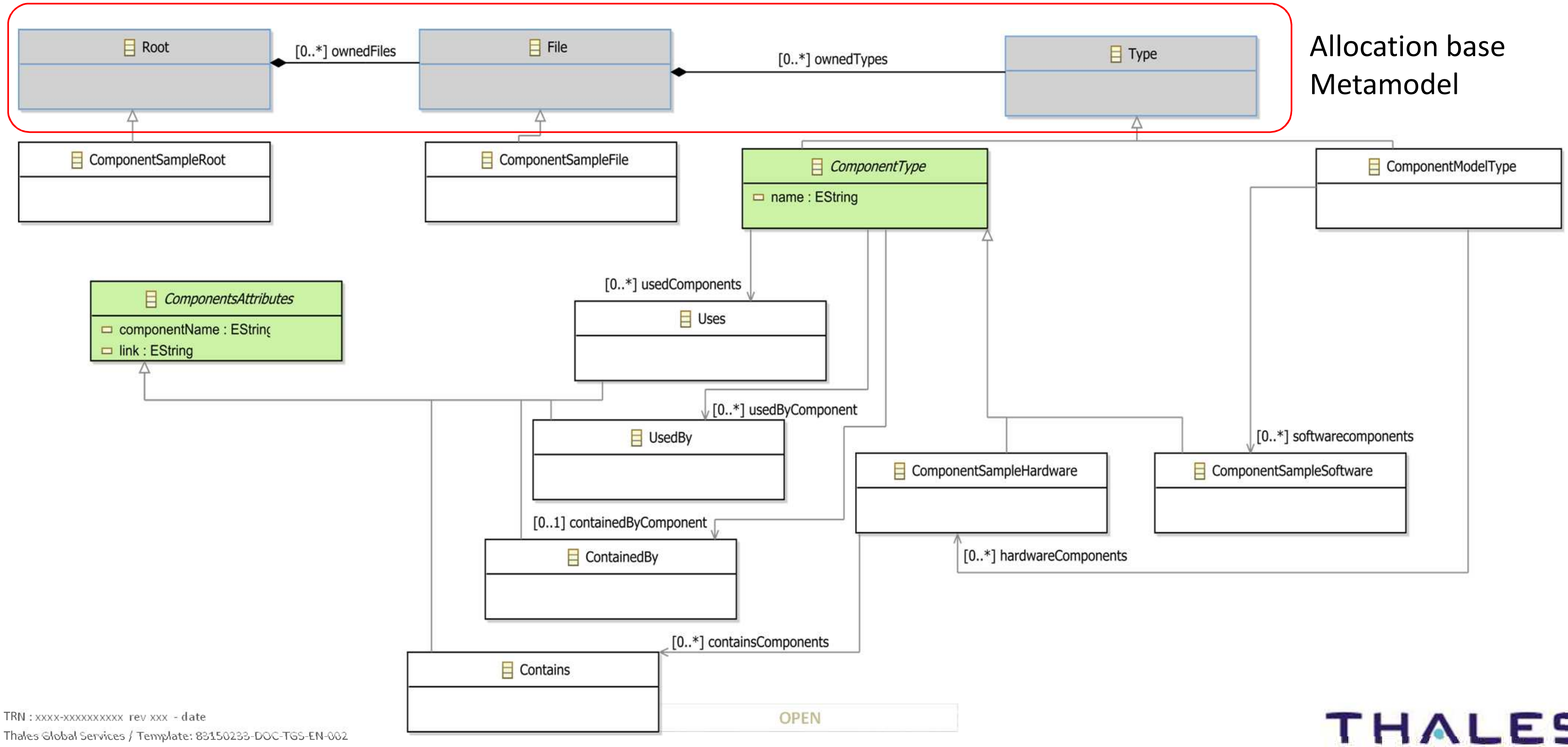
- **Generate One File HTML Documentation**
  - Strategy two (One File Strategy)
    - Create one HTML file which contains all documentation of all components

Examples

- **Step 1: Project Definition Action**
  - Create a new plugin: org.polarsys.kitalpha.m2t.componentsample.to.html
  - Add the dependencies:
    - org.eclipse.ui
    - org.eclipse.core.runtime
    - org.eclipse.emf.ecore
    - org.polarsys.kitalpha.composer.core
    - org.polarsys.kitalpha.composer.metamodel.allocation.base.model
    - org.polarsys.kitalpha.cadence.core
    - org.polarsys.kitalpha.vp.componentsample.model

Example

- **Step 2: Extend allocation base metamodel action**
  - Create a new folder named model
  - Create a new ecore model with nsuri: http://www.polarsys.org/kitalpha/componentsampleallocation/1.0.0
  - Load the allocation base metamodel
  - Create the extension as showed on the diagram
  - Generate the Java model for the extended base allocation metamodel

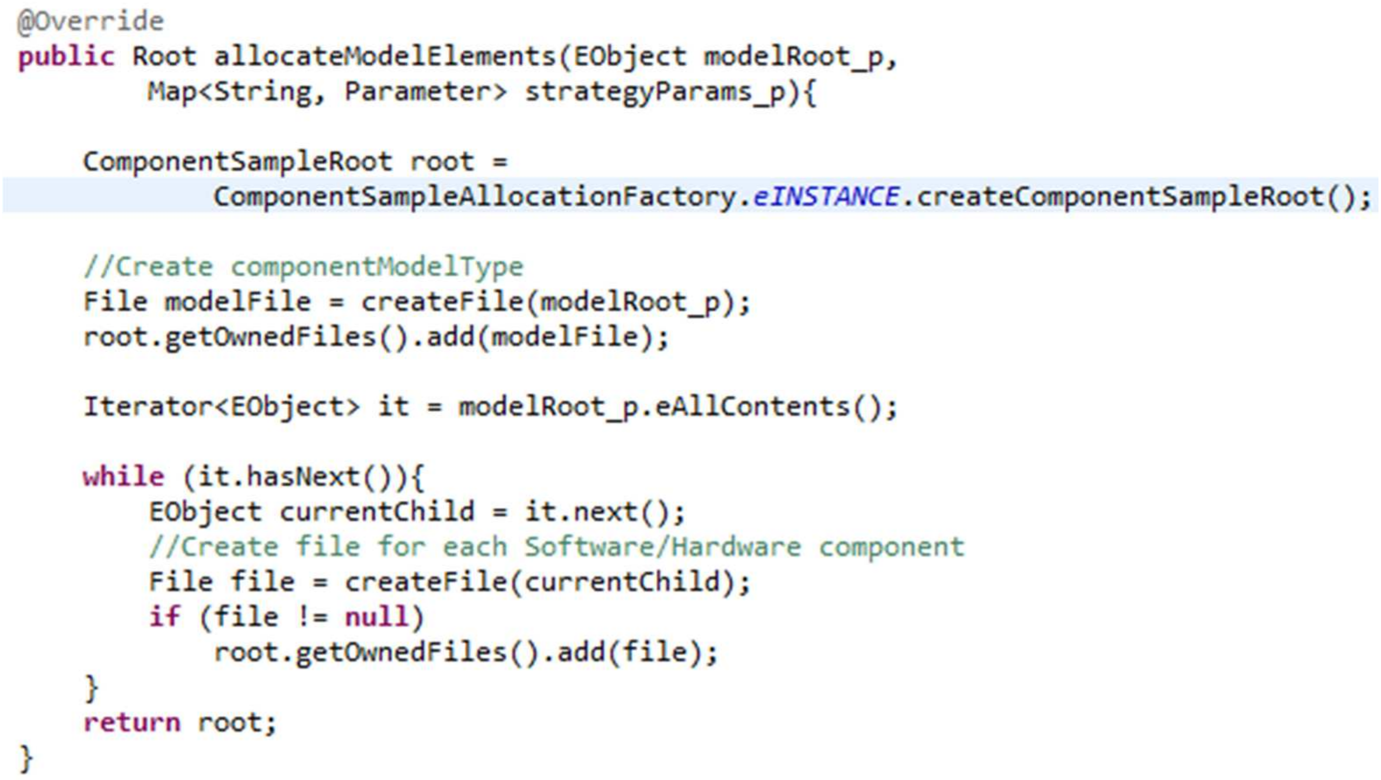


Allocation base Metamodel

Example

- **Step 3 – Composer Contribution Action (1/6)**
  - Bind the extended allocation metamodel to the business model
    - Contribute to org.polarsys.kitalpha.composer.allocation.binding
      - Name: Component Sample to HTML Documentation
      - Id: org.polarsys.kitalpha.m2t.componentsample.to.html.binding
      - NsUri: http://www.polarsys.org/kitalpha/componentsampleallocation/1.0.0
      - Description: Binding between Component Sample Ecore and Component Sample Allocation Ecore
      - Add new business metamodel nsuri declaration, and specify the nsuri: http://www.polarsys.org/kitalpha/ComponentSample
  - Multi files strategy contribution (Use Case 1)
    - Contribute to org.polarsys.kitalpha.composer.allocation.strategies
      - Name: HTML Component Sample Generation Multi Files
      - NsUri: http://www.polarsys.org/kitalpha/componentsampleallocation/1.0.0
      - Id: org.polarsys.kitalpha.m2t.componentsample.to.html.multi.files.strategy
      - Class: org.polarsys.kitalpha.m2t.componentsample.to.html.strategies.MultiFilesStrategy
      - Description: Multi Files Strategy

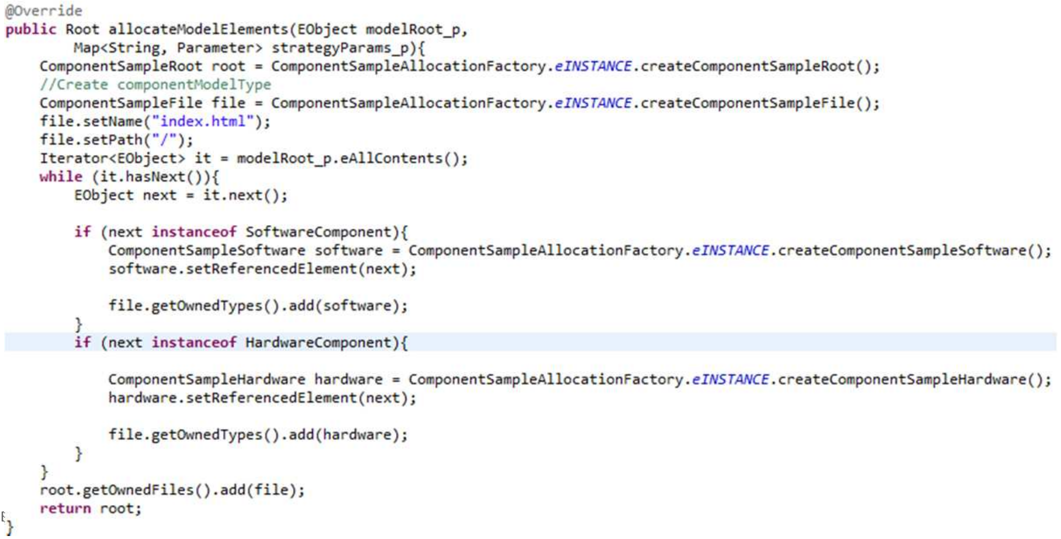
- **Step 3 – Composer Contribution Action (2/6)**
  - o Strategy Multi Files Generation Code Example



```java
@Override
public Root allocateModelElements(EObject modelRoot_p,
        Map<String, Parameter> strategyParams_p){

    ComponentSampleRoot root =
            ComponentSampleAllocationFactory.eINSTANCE.createComponentSampleRoot();

    //Create componentModelType
    File modelFile = createFile(modelRoot_p);
    root.getOwnedFiles().add(modelFile);

    Iterator<EObject> it = modelRoot_p.eAllContents();

    while (it.hasNext()){
        EObject currentChild = it.next();
        //Create file for each Software/Hardware component
        File file = createFile(currentChild);
        if (file != null)
            root.getOwnedFiles().add(file);
    }
    return root;
}
```

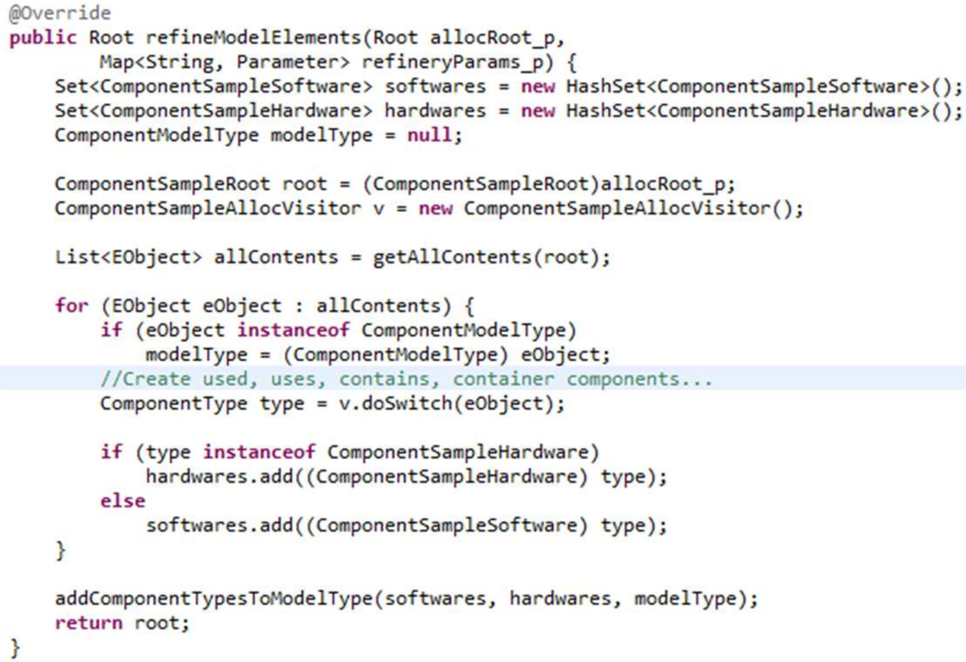
Example

- **Step 3 – Composer Contribution Action (3/6)**
  - One File Generation contribution (Use Case 2)
    - Add a new strategy to strategies extension point
      - Right click on Strategies extension point defined before
      - New Strategy
    - Fill the fields:
      - Name: HTML Component Sample Generation One File
      - NsUri: http://www.polarsys.org/kitalpha/componentsampleallocation/1.0.0
      - Id: org.polarsys.kitalpha.m2t.componentsample.to.html.one.file.strategy
      - Class: org.polarsys.kitalpha.m2t.componentsample.to.html.strategies.OneFileStrategy
      - Description: One File Strategy
  - Strategy One Files Generation Code Example



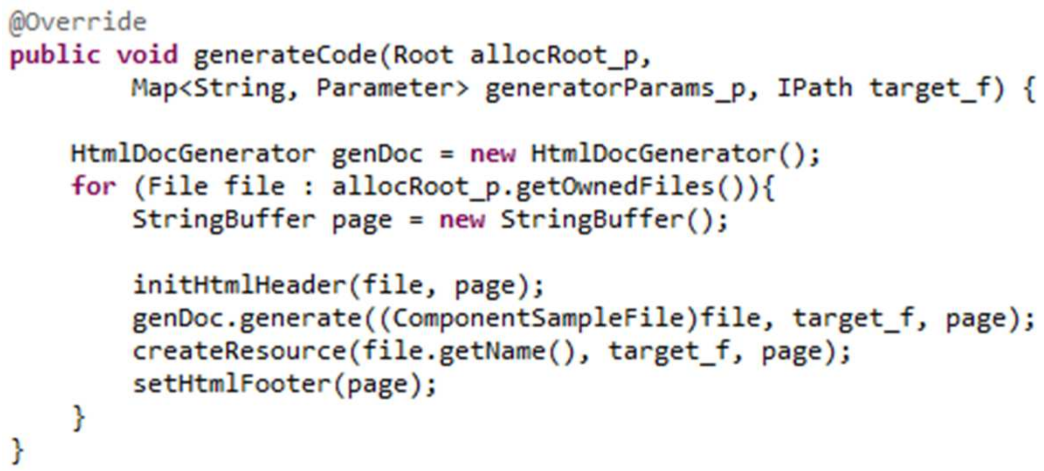
```
@Override
public Root allocateModelElements(EObject modelRoot_p,
        Map<String, Parameter> strategyParams_p){
    ComponentSampleRoot root = ComponentSampleAllocationFactory.eINSTANCE.createComponentSampleRoot();
    //Create componentModelType
    ComponentSampleFile file = ComponentSampleAllocationFactory.eINSTANCE.createComponentSampleFile();
    file.setName("index.html");
    file.setPath("/");
    Iterator<EObject> it = modelRoot_p.eAllContents();
    while (it.hasNext()){
        EObject next = it.next();

        if (next instanceof SoftwareComponent){
            ComponentSampleSoftware software = ComponentSampleAllocationFactory.eINSTANCE.createComponentSampleSoftware();
            software.setReferencedElement(next);

            file.getOwnedTypes().add(software);
        }
        if (next instanceof HardwareComponent){

            ComponentSampleHardware hardware = ComponentSampleAllocationFactory.eINSTANCE.createComponentSampleHardware();
            hardware.setReferencedElement(next);

            file.getOwnedTypes().add(hardware);
        }
    }
    root.getOwnedFiles().add(file);
    return root;
}
```

- **Step 3 – Composer Contribution Action (4/6)**
    - Refinery contribution
        - Contribute to: org.polarsys.kitalpha.composer.allocation.refineries
            - Name: Component Sample Refinery
            - NsUri: http://www.polarsys.org/kitalpha/componentsampleallocation/1.0.0
            - Id: org.polarsys.kitalpha.m2t.componentsample.to.html.refinery
            - Class: org.polarsys.kitalpha.m2t.componentsample.to.html.refineries.ComponentSampleRefinery
            - Description: Component Sample Refinery
    - Refinery Code Example



```
@Override
public Root refineModelElements(Root allocRoot_p,
        Map<String, Parameter> refineryParams_p) {
    Set<ComponentSampleSoftware> softwares = new HashSet<ComponentSampleSoftware>();
    Set<ComponentSampleHardware> hardwares = new HashSet<ComponentSampleHardware>();
    ComponentModelType modelType = null;

    ComponentSampleRoot root = (ComponentSampleRoot)allocRoot_p;
    ComponentSampleAllocVisitor v = new ComponentSampleAllocVisitor();

    List<EObject> allContents = getAllContents(root);

    for (EObject eObject : allContents) {
        if (eObject instanceof ComponentModelType)
            modelType = (ComponentModelType) eObject;
        //Create used, uses, contains, container components...
        ComponentType type = v.doSwitch(eObject);

        if (type instanceof ComponentSampleHardware)
            hardwares.add((ComponentSampleHardware) type);
        else
            softwares.add((ComponentSampleSoftware) type);
    }

    addComponentTypesToModelType(softwares, hardwares, modelType);
    return root;
}
```

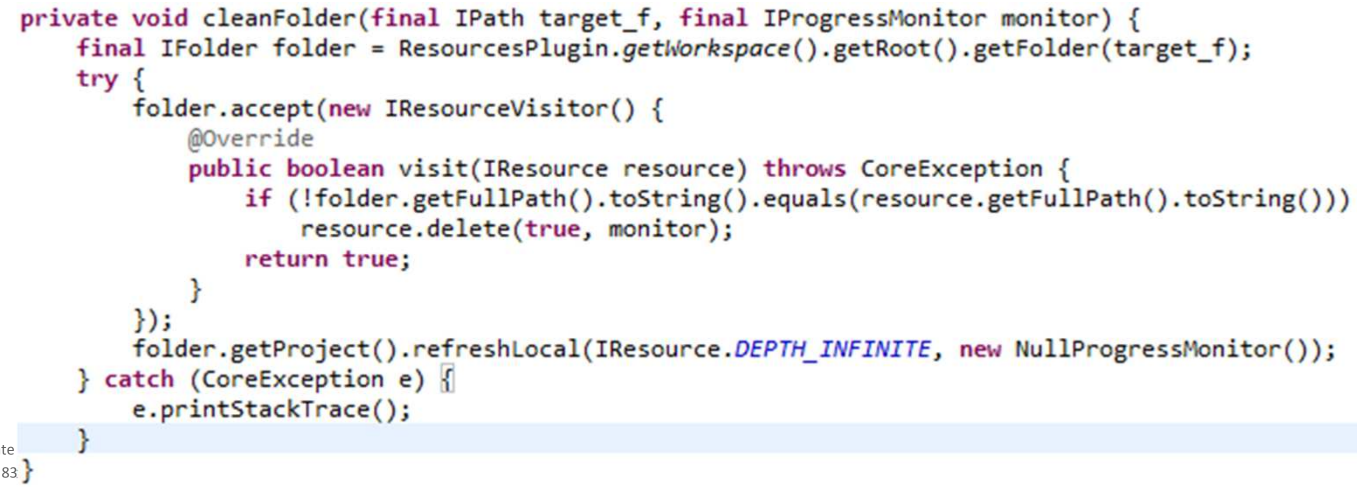
- **Step 3 – Composer Contribution Action (5/6)**
  - Generator contribution
    - Contribute to: org.polarsys.kitalpha.cots.generators
      - Name: Component Sample Generator
      - NsUri: http://www.polarsys.org/kitalpha/componentsampleallocation/1.0.0
      - Id: org.polarsys.kitalpha.m2t.componentsample.to.html.cots
      - Class: org.polarsys.kitalpha.m2t.componentsample.to.html.sysout.generator.ComponentSampleGenerator
      - Description: Component Sample to Html Documentation generator
  - Generator Code Example
    - For each file, launch the generator



```
@Override
public void generateCode(Root allocRoot_p,
        Map<String, Parameter> generatorParams_p, IPath target_f) {

    HtmlDocGenerator genDoc = new HtmlDocGenerator();
    for (File file : allocRoot_p.getOwnedFiles()){
        StringBuffer page = new StringBuffer();

        initHtmlHeader(file, page);
        genDoc.generate((ComponentSampleFile)file, target_f, page);
        createResource(file.getName(), target_f, page);
        setHtmlFooter(page);
    }
}
```

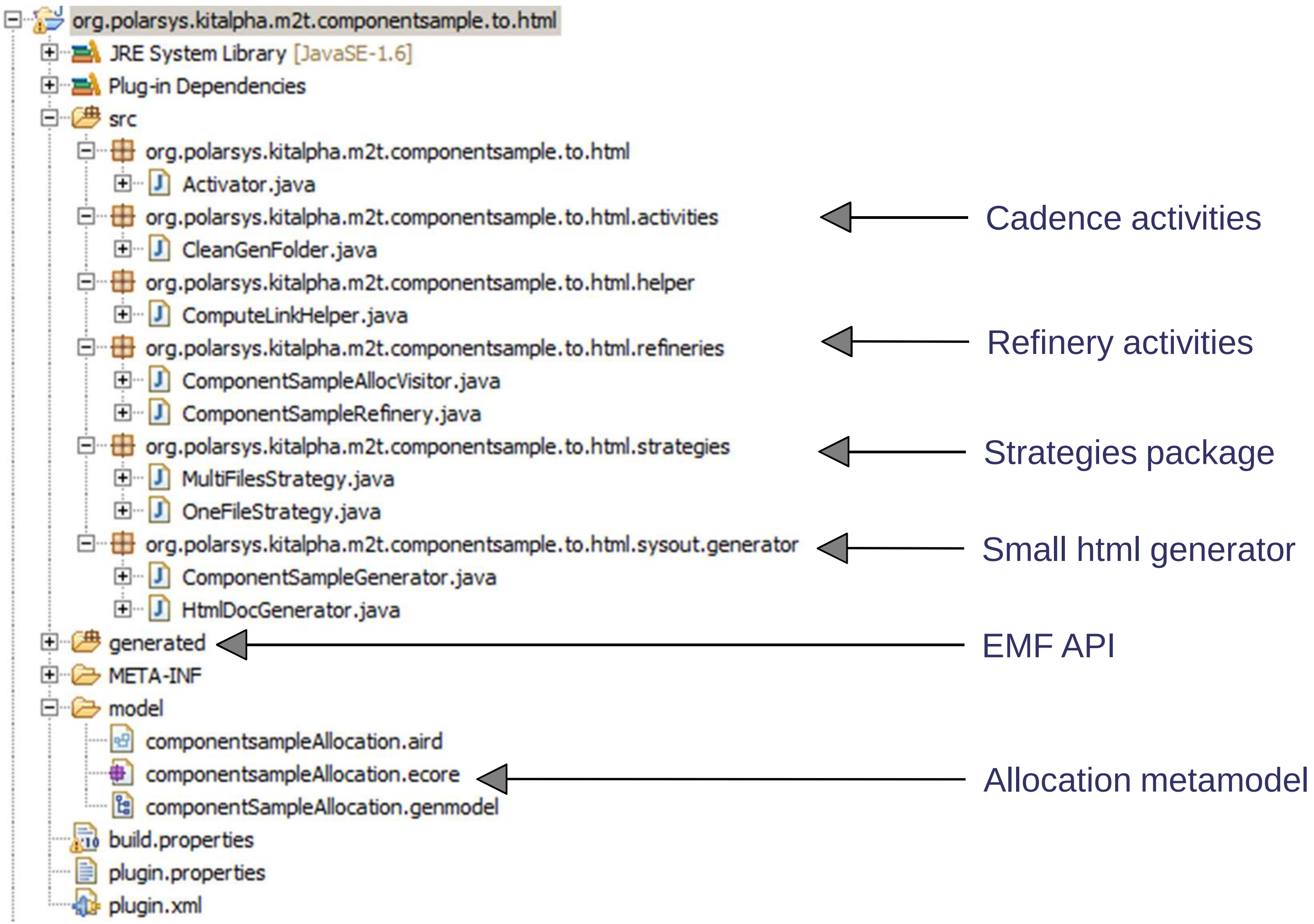
Example

- **Step 3 – Composer Contribution Action (6/6)**
  - Cadence activity – Cleaner of the folder generation
    - Before the file generation, it is good to clean the folder where files are generated
    - Contribute with cadence activity to before generation Composer workflow element
      - Contribute to: org.polarsys.kitalpha.cadence.core.activity.declaration
      - Identifier: org.polarsys.kitalpha.m2t.componentsample.to.html.cleanActivity
      - Name: Folder Cleaner
      - WorkflowIdentifier: org.polarsys.kitalpha.composer.core.workflow
      - WorkflowElementIdentifier: org.polarsys.kitalpha.composer.core.workflow.beforegeneration
      - ActivityClass: org.polarsys.kitalpha.m2t.componentsample.to.html.activities.CleanGenFolder
      - Multiple: false
  - Cadence activity code example



```
private void cleanFolder(final IPath target_f, final IProgressMonitor monitor) {
    final IFolder folder = ResourcesPlugin.getWorkspace().getRoot().getFolder(target_f);
    try {
        folder.accept(new IResourceVisitor() {
            @Override
            public boolean visit(IResource resource) throws CoreException {
                if (!folder.getFullPath().toString().equals(resource.getFullPath().toString()))
                    resource.delete(true, monitor);
                return true;
            }
        });
        folder.getProject().refreshLocal(IResource.DEPTH_INFINITE, new NullProgressMonitor());
    } catch (CoreException e) {
        e.printStackTrace();
    }
}
```

Create a new plugin – hierarchy code below



```
org.polarsys.kitalpha.m2t.componentsample.to.html
    JRE System Library [JavaSE-1.6]
    Plug-in Dependencies
    src
        org.polarsys.kitalpha.m2t.componentsample.to.html
            Activator.java
        org.polarsys.kitalpha.m2t.componentsample.to.html.activities
            CleanGenFolder.java
        org.polarsys.kitalpha.m2t.componentsample.to.html.helper
            ComputeLinkHelper.java
        org.polarsys.kitalpha.m2t.componentsample.to.html.refineries
            ComponentSampleAllocVisitor.java
            ComponentSampleRefinery.java
        org.polarsys.kitalpha.m2t.componentsample.to.html.strategies
            MultiFilesStrategy.java
            OneFileStrategy.java
        org.polarsys.kitalpha.m2t.componentsample.to.html.sysout.generator
            ComponentSampleGenerator.java
            HtmlDocGenerator.java
    generated
    META-INF
    model
        componentsampleAllocation.aird
        componentsampleAllocation.ecore
        componentSampleAllocation.genmodel
    build.properties
    plugin.properties
    plugin.xml
```

Cadence activities

Refinery activities

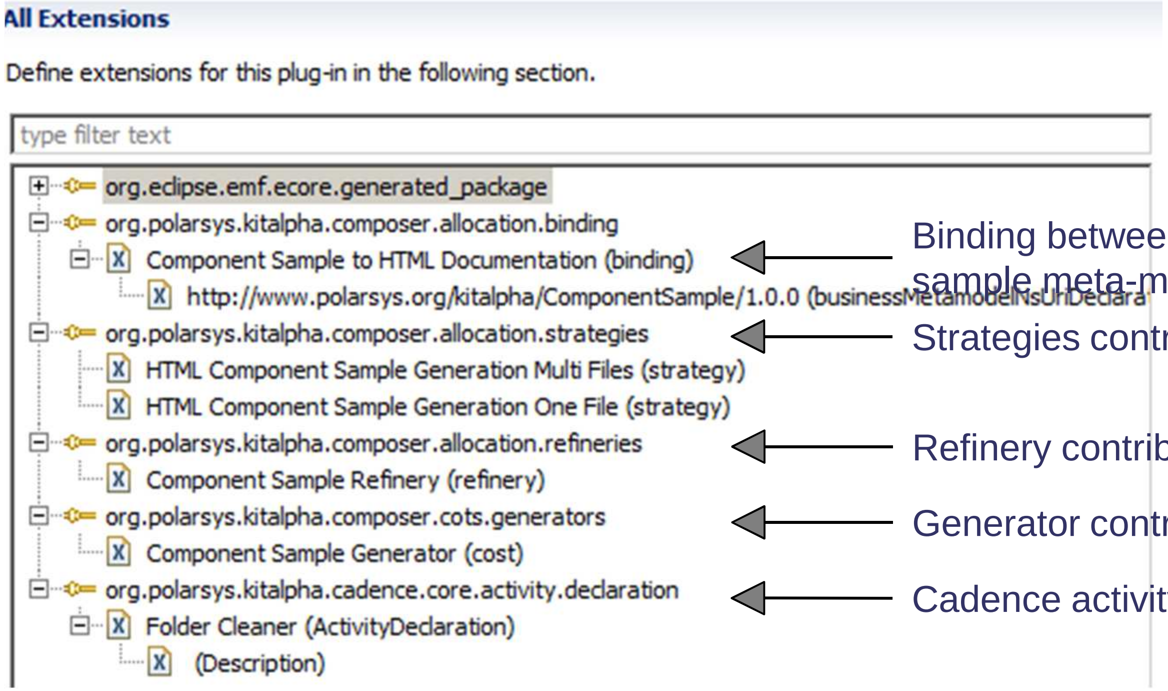
Strategies package

Small html generator

EMF API

Allocation metamodel

Composer extension points contributions



All Extensions

Define extensions for this plug-in in the following section.

type filter text

```
⊞ org.eclipse.emf.ecore.generated_package
⊟ org.polarsys.kitalpha.composer.allocation.binding
    ⊟ Component Sample to HTML Documentation (binding)
        http://www.polarsys.org/kitalpha/ComponentSample/1.0.0 (businessMetamodelNsUriDeclara
⊟ org.polarsys.kitalpha.composer.allocation.strategies
    HTML Component Sample Generation Multi Files (strategy)
    HTML Component Sample Generation One File (strategy)
⊟ org.polarsys.kitalpha.composer.allocation.refineries
    Component Sample Refinery (refinery)
⊟ org.polarsys.kitalpha.composer.cots.generators
    Component Sample Generator (cost)
⊟ org.polarsys.kitalpha.cadence.core.activity.declaration
    ⊟ Folder Cleaner (ActivityDeclaration)
        (Description)
```

Binding between Allocation and Component sample meta-model

Strategies contribution

Refinery contribution

Generator contribution

Cadence activity contribution

Example

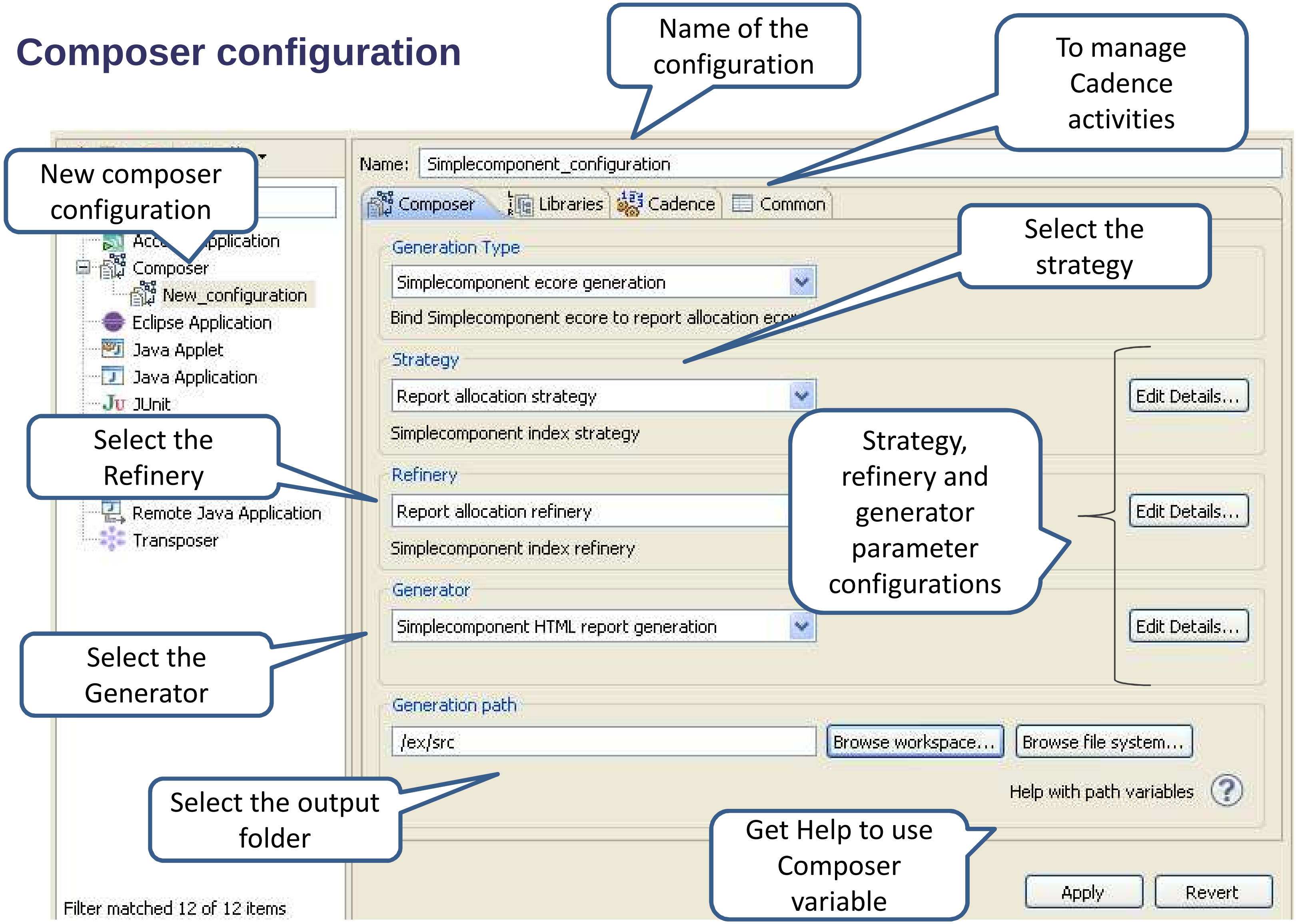
Play the example

- **Launch a new instance of Kitalpha**
- **Create a new project or plugin**
- **Create a model folder**
- **Create a new ComponentSample model or import one.**
- **Create a Composer launch configurations**
  - Choose a generation type
  - Choose a Strategy (One or Mutli files strategy)
  - Choose the Refinery
  - Choose the generator
  - Choose the folder where files will be generated
  - Add folder clean activity to “Before Generated” workflow element
  - Specify folder generation as parameter of the activity
- **Right click on ComponentSample Model, then, Run Composer , then, componentSample to HTML Documentation**

Example

- **Launch a new instance of Kitalpha**

Composer configuration



Name: Simplecomponent_configuration

Generation Type: Simplecomponent ecore generation

Bind Simplecomponent ecore to report allocation ecore

Strategy: Report allocation strategy

Simplecomponent index strategy

Refinery: Report allocation refinery

Simplecomponent index refinery

Generator: Simplecomponent HTML report generation

Generation path: /ex/src

Name of the configuration

To manage Cadence activities

New composer configuration

Select the strategy

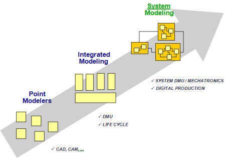
Select the Refinery

Strategy, refinery and generator parameter configurations

Select the Generator

Select the output folder

Get Help to use Composer variable



Kitalpha is supported by **Sys2Soft** and **Crystal**, respectively French and European projects

Thαnk You!

https://www.polarsys.org/projects/polarsys.kitalpha

https://polarsys.org/wiki/Kitalpha

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#LangloisBenoit