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Eclipse Transformation Training


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Introductions


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Introduction - Instructors
Workshop leader
Toby McClean
Principal Technology Specialist
Modeling, Domain Specific Modeling and Languages
Model transformations and code generation
Component based development and standards
Facilitators
Mark Hermeling (week 1)
Director, Product Technology
Tim McGuire (week 2)
Senior Software Engineering Specialist
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Introductions - Participants
Briefly, a little about you
Name
Department
What is your interest in Eclipse and the Rational Modeling Platform
Experience
With Eclipse
With RSA, RSD or RSM
How do you expect to apply what you learn this week
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Workshop Goals
Workshop contents
Provide a high-level overview of Eclipse technologies
Related to modeling, domain specialization and transformation
Give you the chance to gain hands-on experience
With programmatically creating and transforming models
The second bullet requires significant detail
What you will be able to do after the workshop
You will understand the possibilities of Eclipse and RSA-RTE
And have a good idea how to extend this environment for your day-to-day activities
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Workshop Agenda
Monday
Architecture overview
Eclipse modeling overview
Tuesday
EMF in depth
UML in depth
Wednesday
Transformation 1
Thursday
Transformation 2
Validation
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Schedule
9:00-10:30
10:45-12:00
13:00-15:00
15:15-17:00
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Workshop Make-Up
Half of this workshop will be slide material
Half of it will be exercises and discussions
Typical flow
Presentation of module
Discussion on how to apply to Ericsson's environment
Exercise introduction
Exercise
Wrap-up of topic
This is a custom-built course for Ericsson
We encourage discussion and exploration
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Workshop Materials
Workbook with slides
Workbook with exercises
VMWare image with Eclipse pre-installed
Solution files
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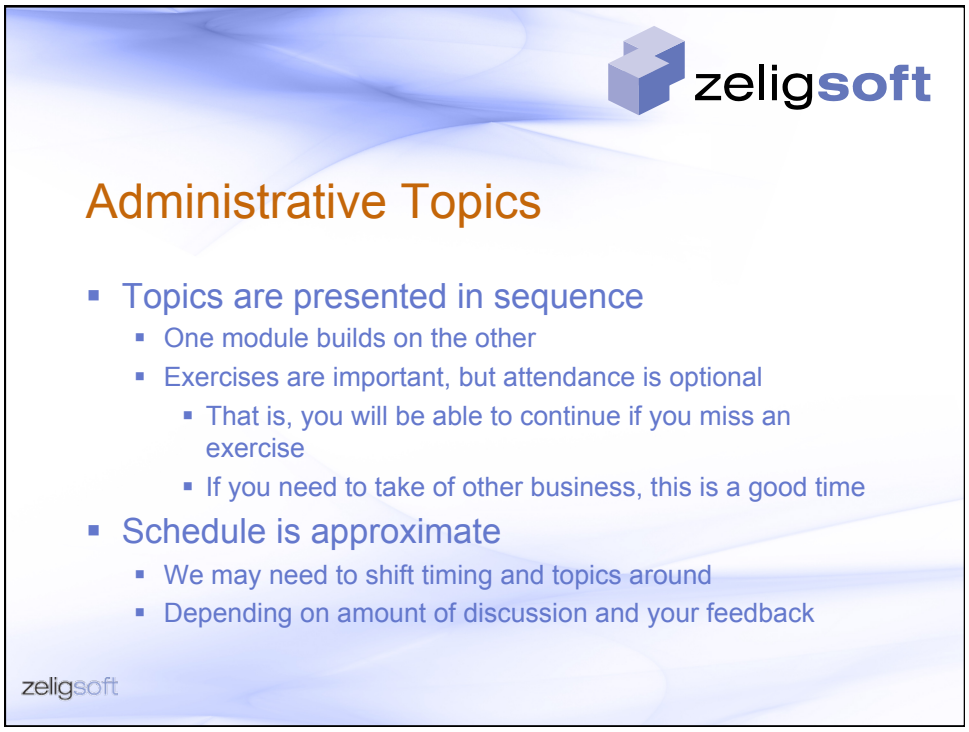
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Administrative Topics
Topics are presented in sequence
One module builds on the other
Exercises are important, but attendance is optional
That is, you will be able to continue if you miss an exercise
If you need to take of other business, this is a good time
Schedule is approximate
We may need to shift timing and topics around
Depending on amount of discussion and your feedback
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The Eclipse Project
An introduction to the Eclipse Project


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Overview
In this module we will explore the Eclipse Project including the different aspects of the Eclipse Workbench.
We will also explore how to develop and deploy plug-ins to extend the Eclipse Workbench.
Some content taken from
Developing Plug-ins for Eclipse (http://www.eclipse.org/resources/)
by Dwight Deugo and Nesa Matic


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Goals
Following the completion of this module and its exercises you will
Have an understanding of the Eclipse Workbench
Know some of the terminology used within the Eclipse Workbench
Have an understanding of the Eclipse architecture
Have an understanding of how Eclipse is extended
Be able to develop and deploy a basic plug-in


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Agenda
What is Eclipse?
The Eclipse Workbench
The Eclipse Architecture
Extending the Workbench


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What is Eclipse?
Eclipse is an open source project
http://www.eclipse.org
Consortium of companies, including IBM
Launched in November, 2001
Designed to help developers with specific development tasks


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Projects
On topic
Business Intelligence and Reporting Tools (BIRT)
Device Software Development Platform
Eclipse Project
Eclipse Modeling Project
Off topic
Data Tools Platform
Eclipse RT
SOA Tools
Eclipse Technology Project
Tools Project
Test and Performance Tools Platform Project
Eclipse Web Tools Platform Project
http://www.eclipse.org/projects/listofprojects.php


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Brief History of Eclipse
1994
VisualAge for Smalltalk
1996
VisualAge for Java
1996-2001
VisualAge Micro Edition
2001
Eclipse Project


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The Motivation Behind Eclipse
Support for the construction of application development tools
Support for the development of GUI and non-GUI application development
Support for multiple content types
Java, HTML, C, XML
Facility the integration of tools
Cross-platform support

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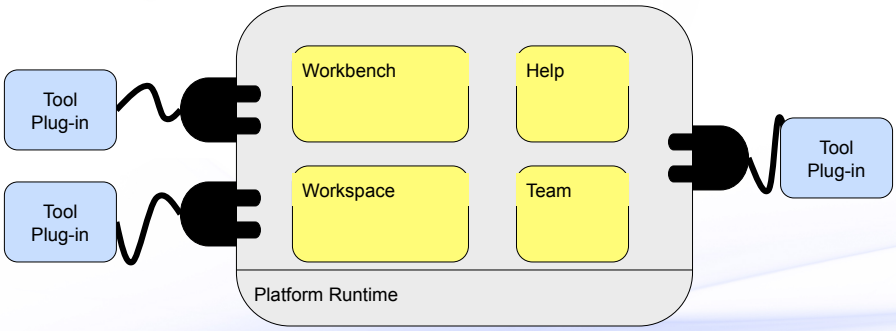
Eclipse Architecture



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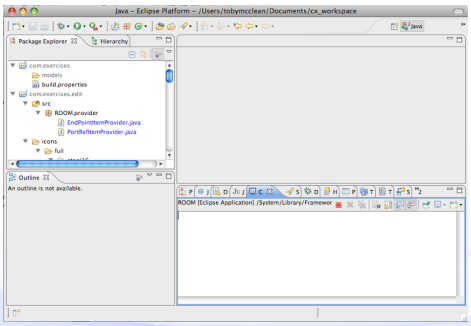
Workbench

- The desktop development environment
  - Tools for resource management
  - Common of navigating through resources
- Multiple workbenches can be opened at the same time
  - Different workspaces



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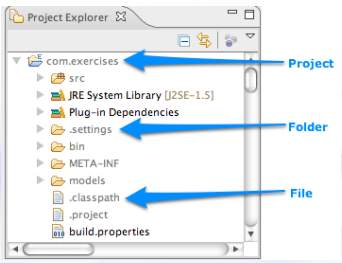
Workspace

- Represents the user data
- A set of resources
  - Projects
    - Collection of files and folders
  - Folders
    - Contain other folders or files
  - Files



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Help

- For the creation and publishing of documentation
- Supports both
  - User guides
  - Programmer guides
- Created using
  - HTML for content
  - XML for navigation
- Support for context sensitive help

Toby McClean, Zeligsoft, 2008


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Team
Provides support for
Versioning
Configuration management
Integration with team repository
Allows team repository provider to hook into environment
Team repository providers specify how to intervene with resources
Has optimistic and pessimistic locking support


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How is Eclipse Used?
As an Integrated Development Environment
Supports the manipulation of multiple content types
Used for specifying and designing applications
Requirements, models, documentation, etc.
Used for writing code
Java, C, C++, C#, Python, ...
As a product base
Supported through plug-in architecture and customizations


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Eclipse as an IDE
Java Development Tooling
Editors, compiler integration, ant integration, debugger integration, etc.
C/C++ Development Tooling
Editors, compiler integration, make integration, debugger integration, etc.
Dynamic languages
Editors, interpreter and compiler integration, debugger integration, etc.
Modeling projects


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Eclipse as a Product Base
Eclipse can be used a Java product base
Its flexible architecture can be used as product framework
Reuse plug-in architecture
Create new plug-ins
Customize the environment
Support for branding
Rich client platform support


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Rich Client Platform
A minimal set of Eclipse plug-ins necessary for building a product
Control over resource model
Control over look and feel
But still capable of leveraging existing plug-ins


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Summary
In this module we explored
Eclipse, its background and the components that form its foundation
Eclipse use cases


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Agenda
What is Eclipse?
The Eclipse Workbench
The Eclipse Architecture
Extending the Workbench


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The Eclipse Project
The Eclipse Workbench

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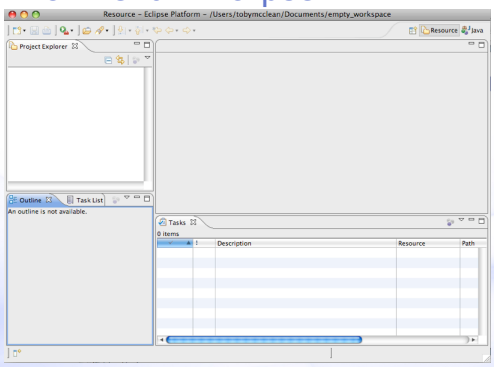
What is the Workbench?

- The working environment in Eclipse



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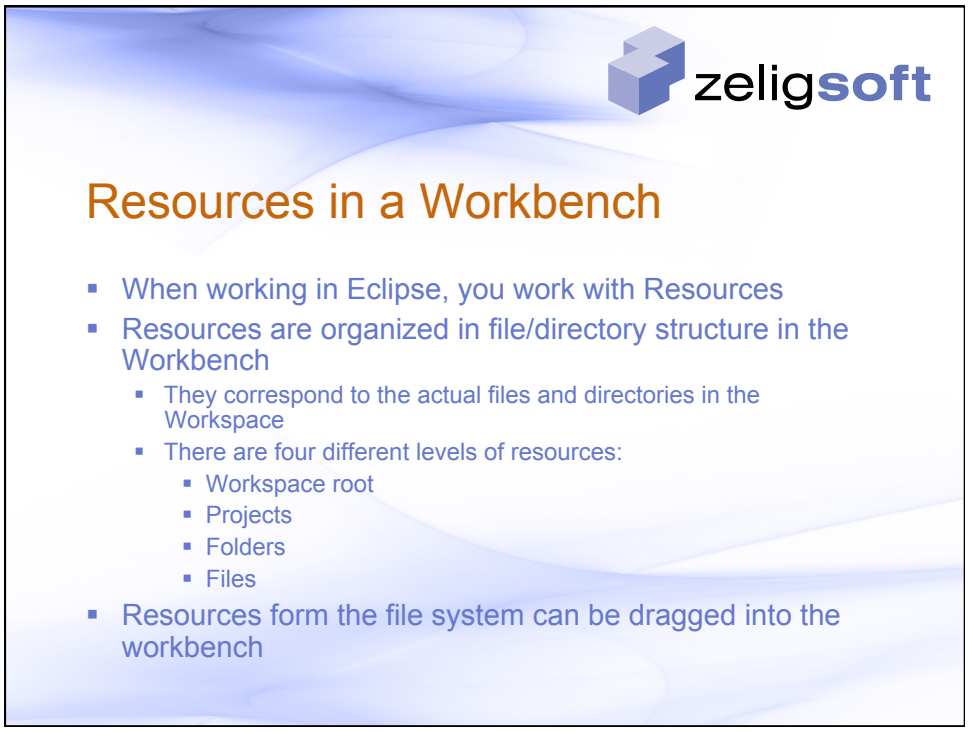
Multiple Workbench Instances

- Instance of Workbench comes up when Eclipse is launched
- It is possible to open another window for the Workbench
  - Window → New Window
  - This opens up a new Workbench window
  - Can have different perspectives open in the different windows
  - Same result is not achieved by launching Eclipse twice



Toby McClean, Zeligsoft, 2008

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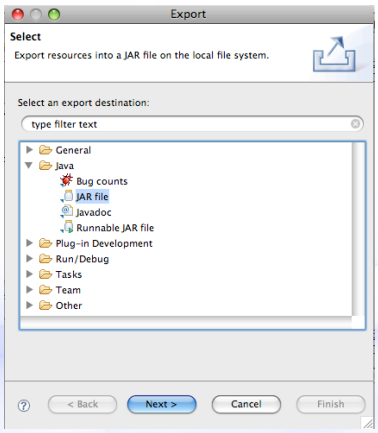
Exporting Resources

- Available through
  - Menu option **File → Export...**
  - Right-click menu **Export...** option on a Resource in the Workbench



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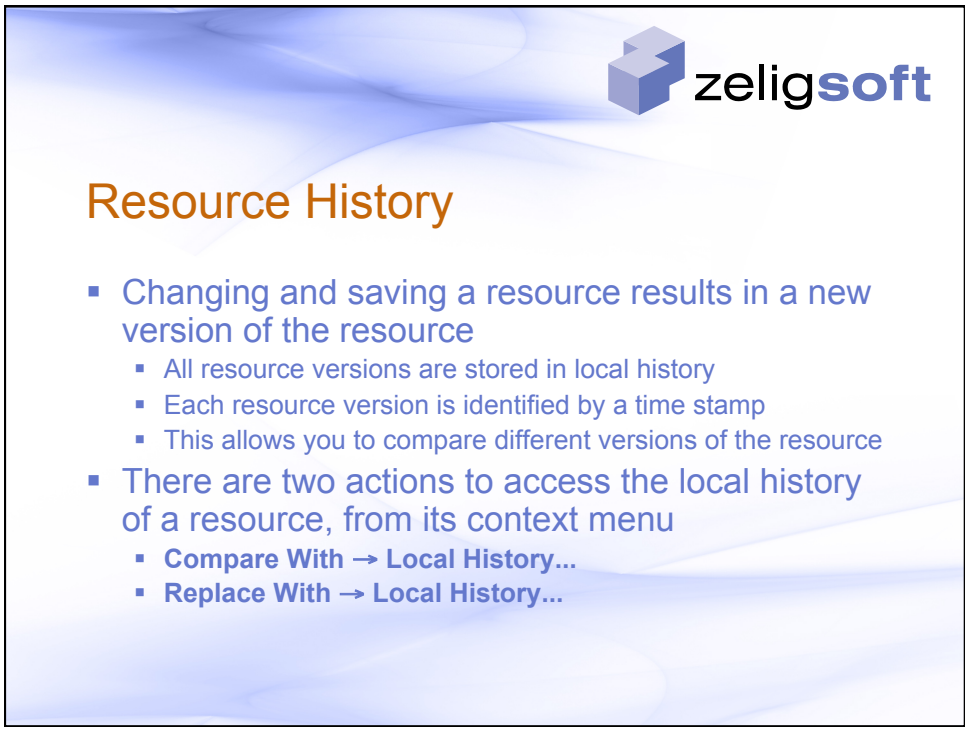
Refreshing Workbench

- Used for refreshing resources that change in the Workspace outside the workbench
- For example, if a file added to a directory in the Workspace
  - Select the project or directory in the workbench
  - Choose **Refresh** from its context menu
  - Alternatively you can press the **F5 button** on your keyboard
- Best practice
  - Work with the resources from within the Workbench when possible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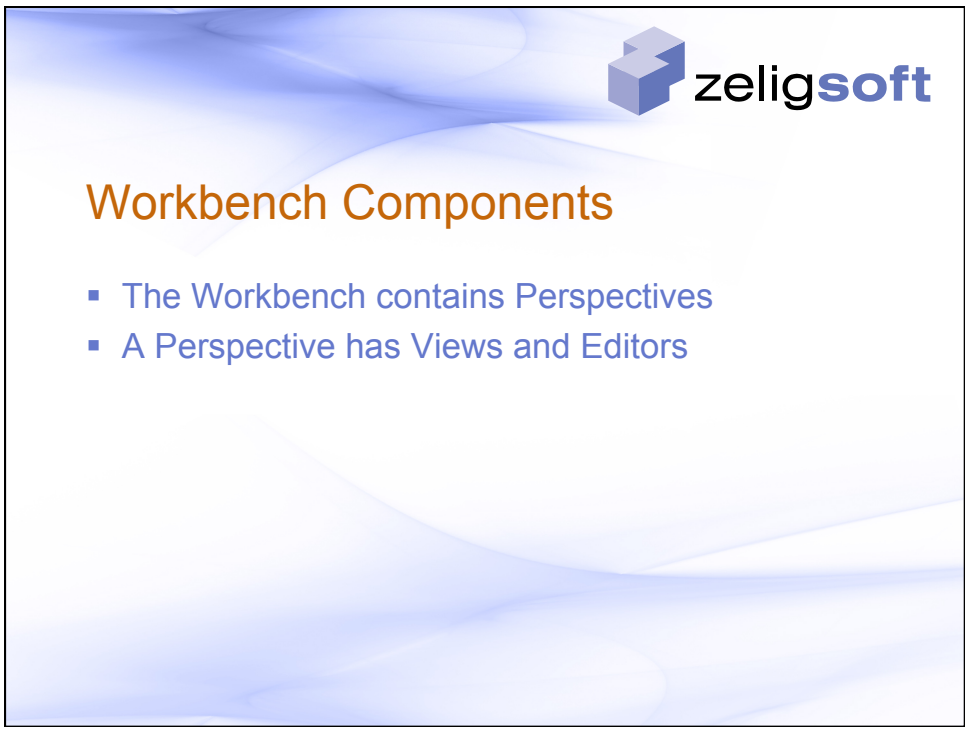
Resource History
Changing and saving a resource results in a new version of the resource
All resource versions are stored in local history
Each resource version is identified by a time stamp
This allows you to compare different versions of the resource
There are two actions to access the local history of a resource, from its context menu
Compare With → Local History...
Replace With → Local History...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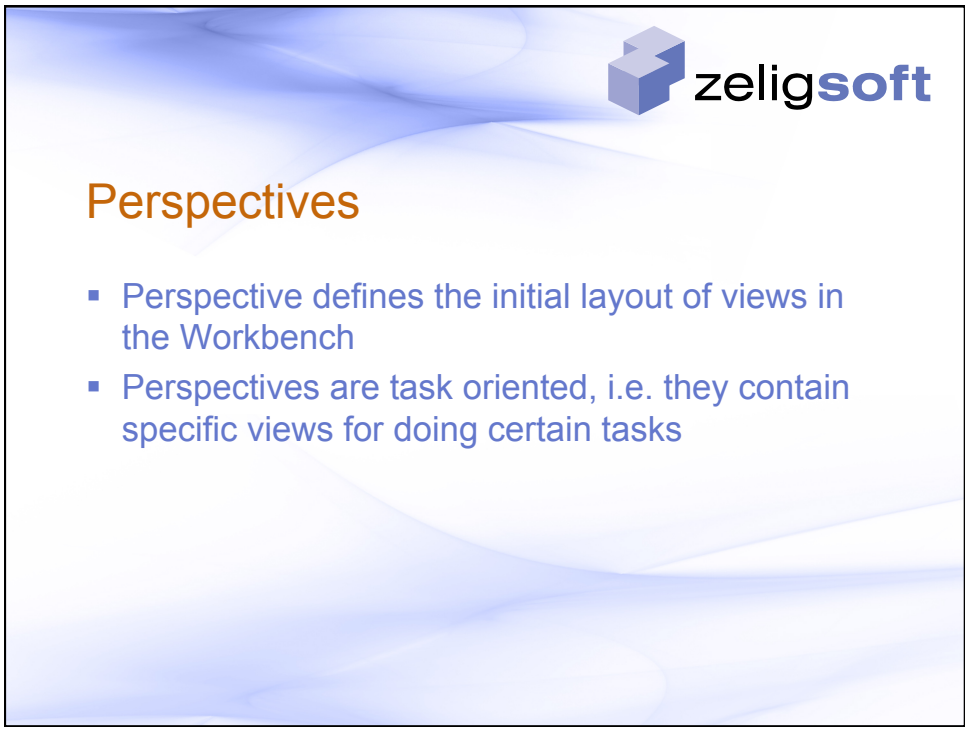
Workbench Components
The Workbench contains Perspectives
A Perspective has Views and Editors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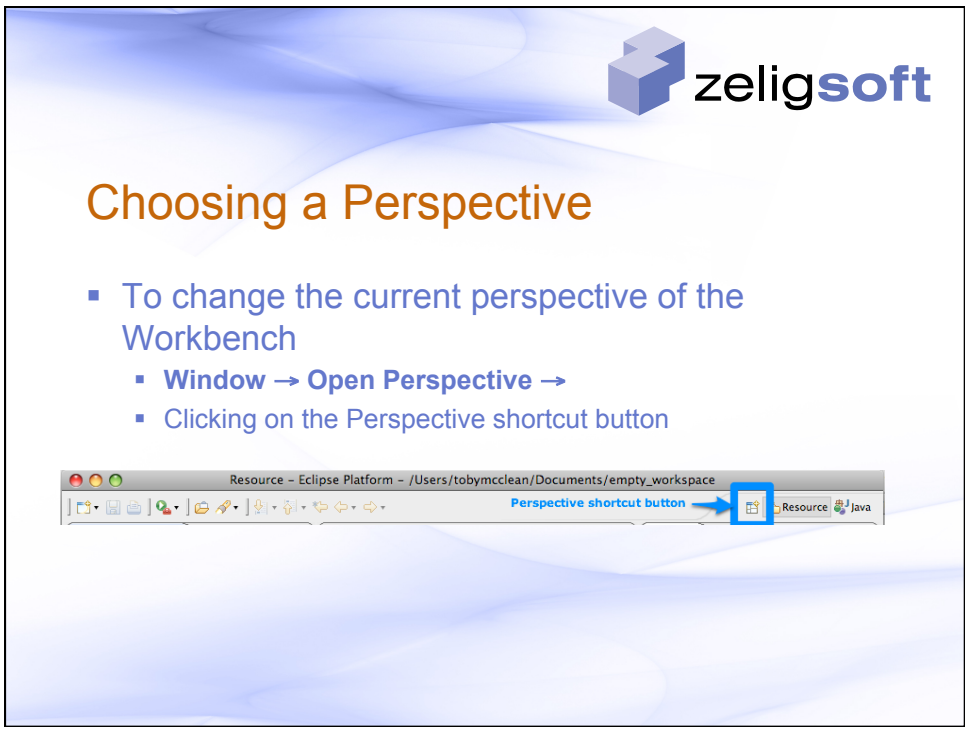
Perspectives
Perspective defines the initial layout of views in the Workbench
Perspectives are task oriented, i.e. they contain specific views for doing certain tasks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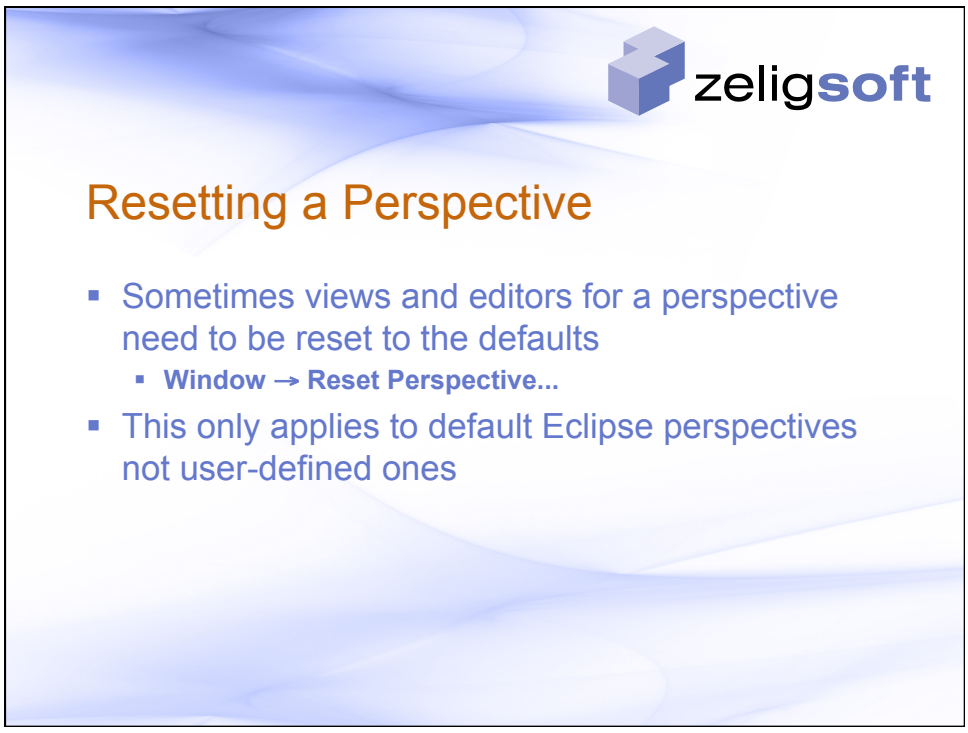
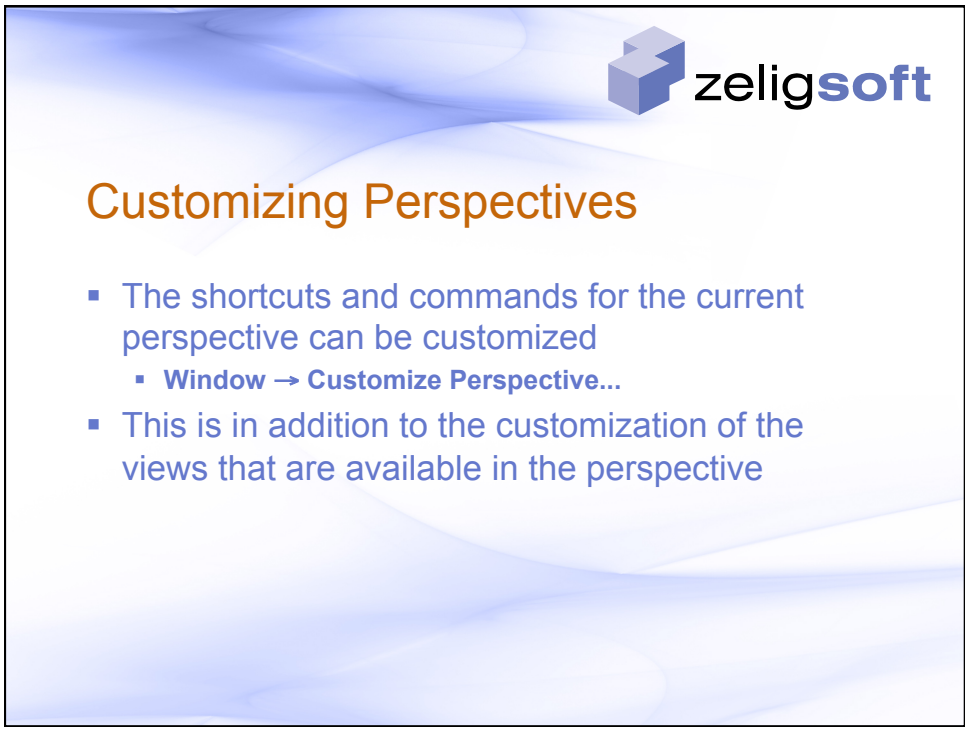
Choosing a Perspective
To change the current perspective of the Workbench
Window → Open Perspective →
Clicking on the Perspective shortcut button
Resource – Eclipse Platform – /Users/tobymcclean/Documents/empty_workspace
Perspective shortcut button
Resource
Java



Toby McClean, Zeligsoft, 2008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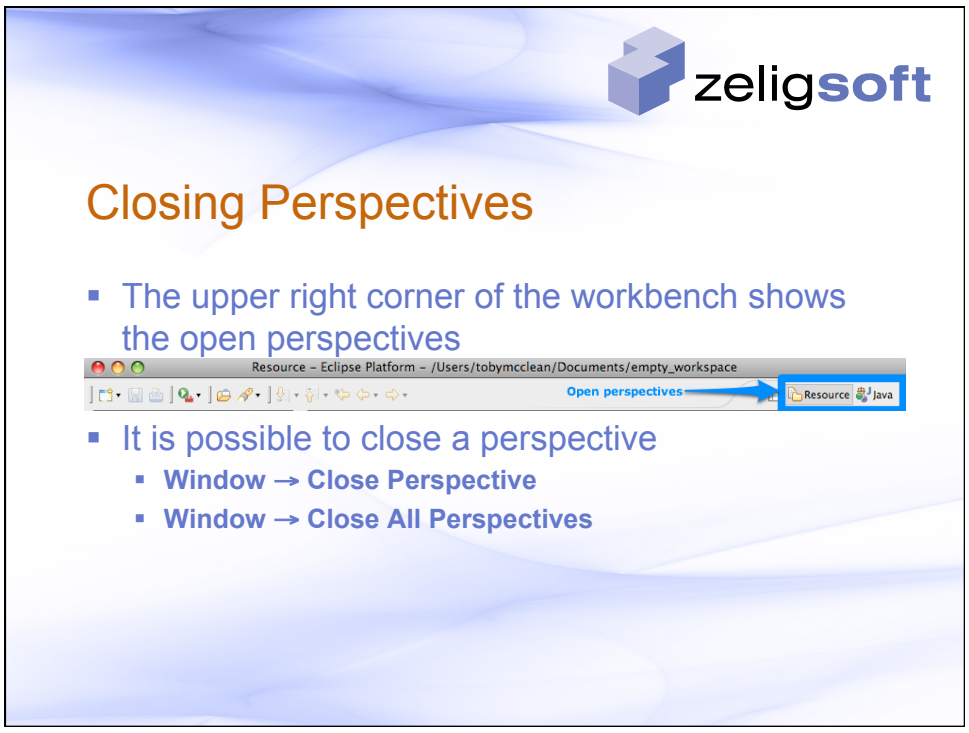
Customizing Perspectives
The shortcuts and commands for the current perspective can be customized
Window → Customize Perspective...
This is in addition to the customization of the views that are available in the perspective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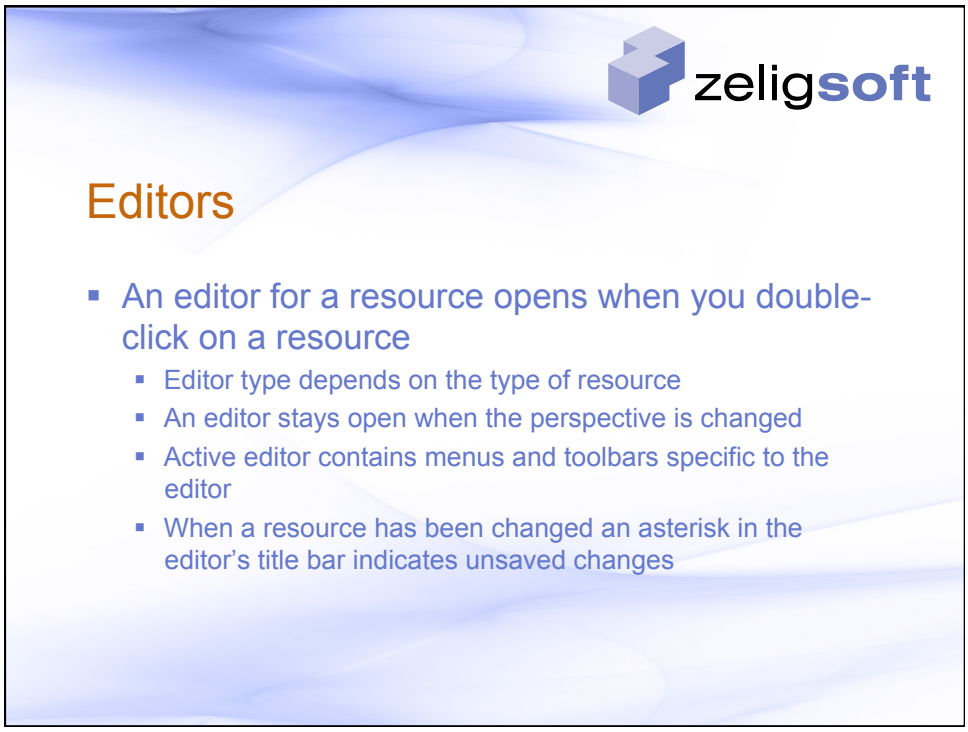
Closing Perspectives
The upper right corner of the workbench shows the open perspectives
Resource – Eclipse Platform – /Users/tobymcclean/Documents/empty_workspace
Open perspectives
Resource
Java
It is possible to close a perspective
Window → Close Perspective
Window → Close All Perspectives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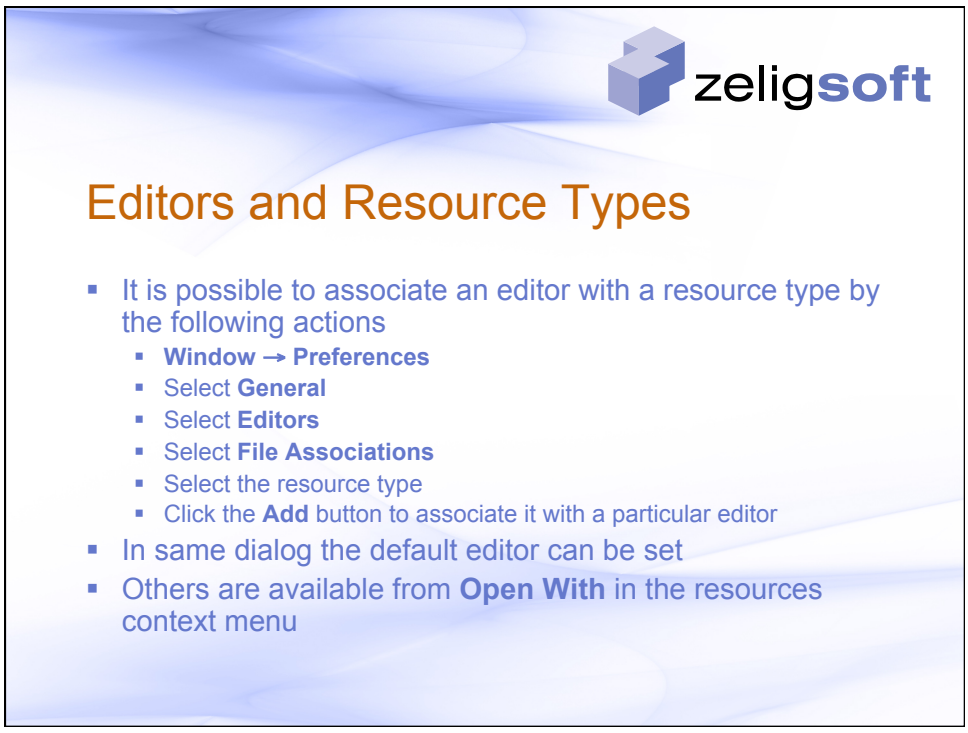
Editors
An editor for a resource opens when you double-click on a resource
Editor type depends on the type of resource
An editor stays open when the perspective is changed
Active editor contains menus and toolbars specific to the editor
When a resource has been changed an asterisk in the editor's title bar indicates unsaved changes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Editors and Resource Types
It is possible to associate an editor with a resource type by the following actions
Window → Preferences
Select General
Select Editors
Select File Associations
Select the resource type
Click the Add button to associate it with a particular editor
In same dialog the default editor can be set
Others are available from Open With in the resources context menu


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Views
The main purpose of a view is
Support editors
Provide alternative presentation and navigation
Views can have their own menus and toolbars
Items available in menus and toolbars are only available in that view


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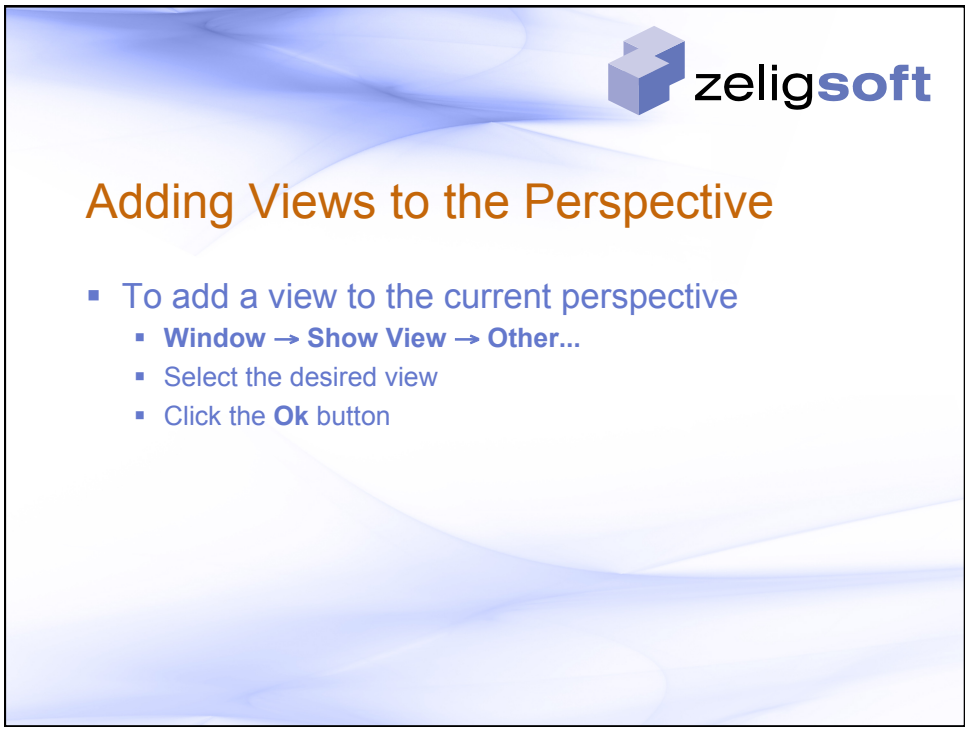
More Views
Views can
Appear on their own
Appear stacked with other views
Layout of views can be changed by clicking on the title bar and moving views
Single views can be moved together with other views
Stacked views can be moved to be single views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Adding Views to the Perspective
To add a view to the current perspective
Window → Show View → Other...
Select the desired view
Click the Ok button


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Stacked Views and Stacking Views
Stacked views appear in a notebook form
Each view is a page in the notebook
A view can be added to a stack by dragging into the area of the tab area of the 'notebook'
Similarly a view can be removed from a stack by dragging its tab away from the 'notebook'


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Fast Views
A fast view is hidden and can be quickly opened and closed
Created by
Dragging an open view to the shortcut bar
Selecting Fast View from the view's menu
A fast view is activated by clicking on its Fast View pop-up menu option
Bottom right of the workbench
Deactivates as soon as focus is given to another view or editor


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Summary
In this module we explored
Components of the Eclipse workbench
Perspectives;
Editors; and
Views


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Agenda
What is Eclipse?
The Eclipse Workbench
The Eclipse Architecture
Extending the Workbench


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The Eclipse Project
Eclipse Architecture

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Eclipse Architecture

- Flexible, structured around
  - Extension points
  - Plug-ins
- Architecture allows for
  - Other tools to be used within the platform
  - Other tools to be extended
  - Integration between tools and the platform

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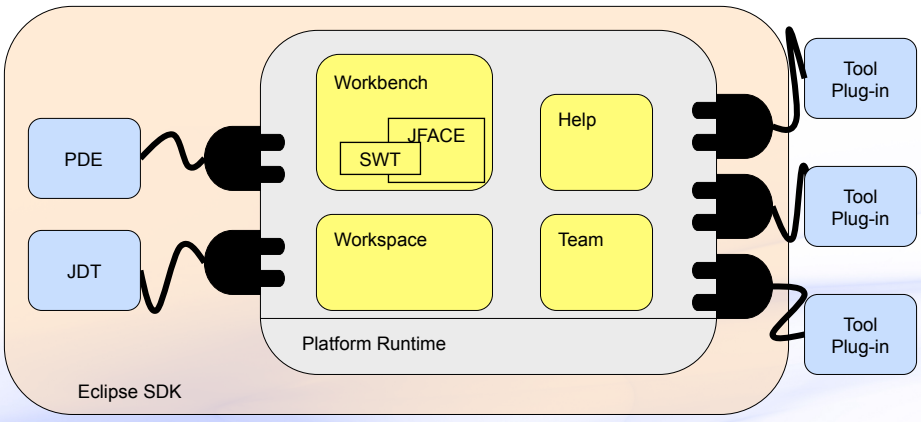
More Eclipse Architecture

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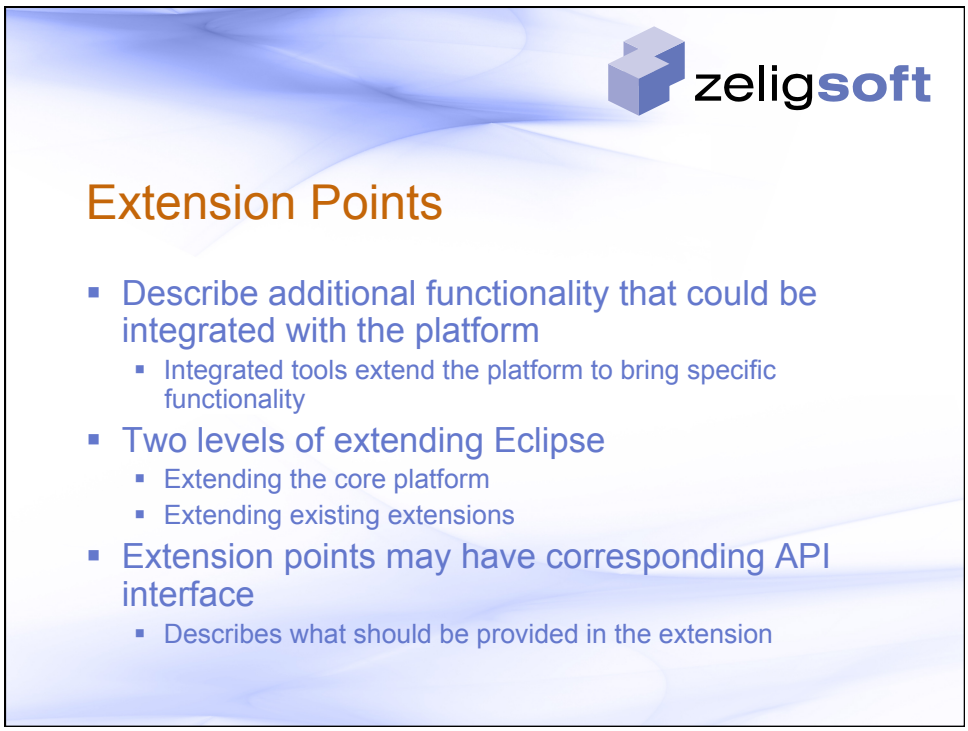
Platform Runtime
Everything is a plug-in except the Platform Runtime
A small kernel that represents the base of the Platform
All other subsystems build up on the Platform Runtime following the rules of plug-ins
i.e. they are plug-ins themselves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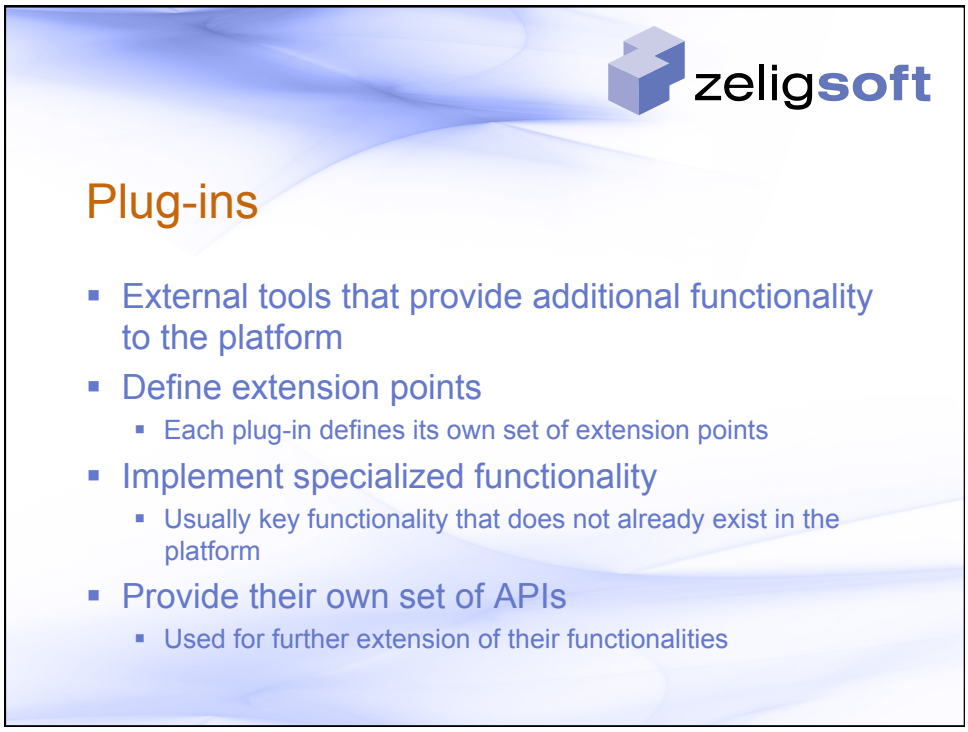
Extension Points
Describe additional functionality that could be integrated with the platform
Integrated tools extend the platform to bring specific functionality
Two levels of extending Eclipse
Extending the core platform
Extending existing extensions
Extension points may have corresponding API interface
Describes what should be provided in the extension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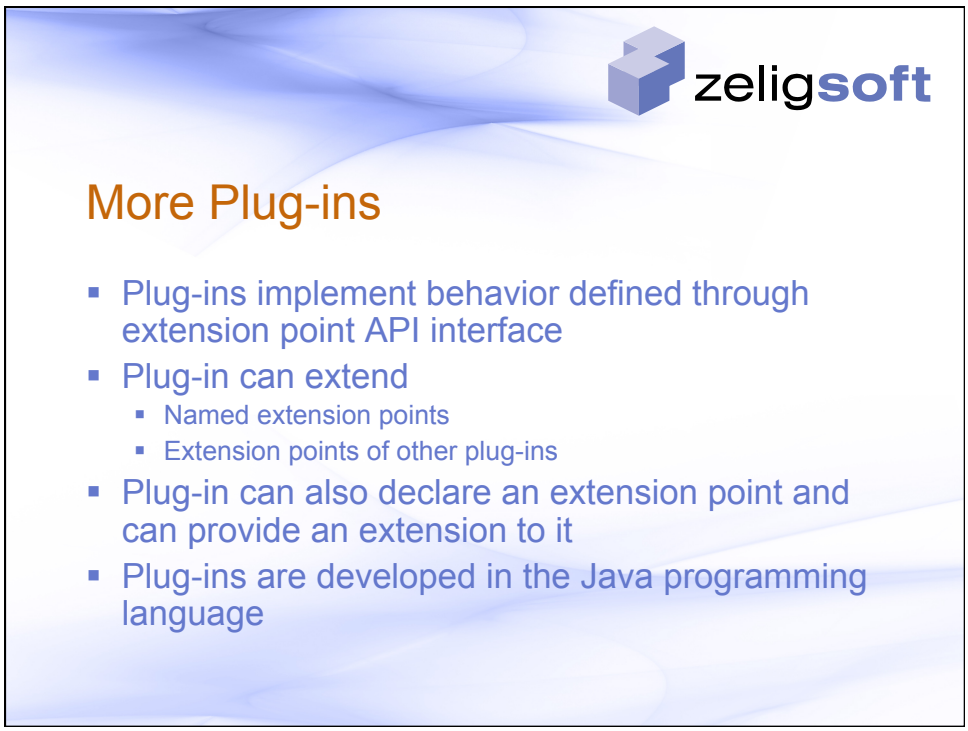
Plug-ins
External tools that provide additional functionality to the platform
Define extension points
Each plug-in defines its own set of extension points
Implement specialized functionality
Usually key functionality that does not already exist in the platform
Provide their own set of APIs
Used for further extension of their functionalities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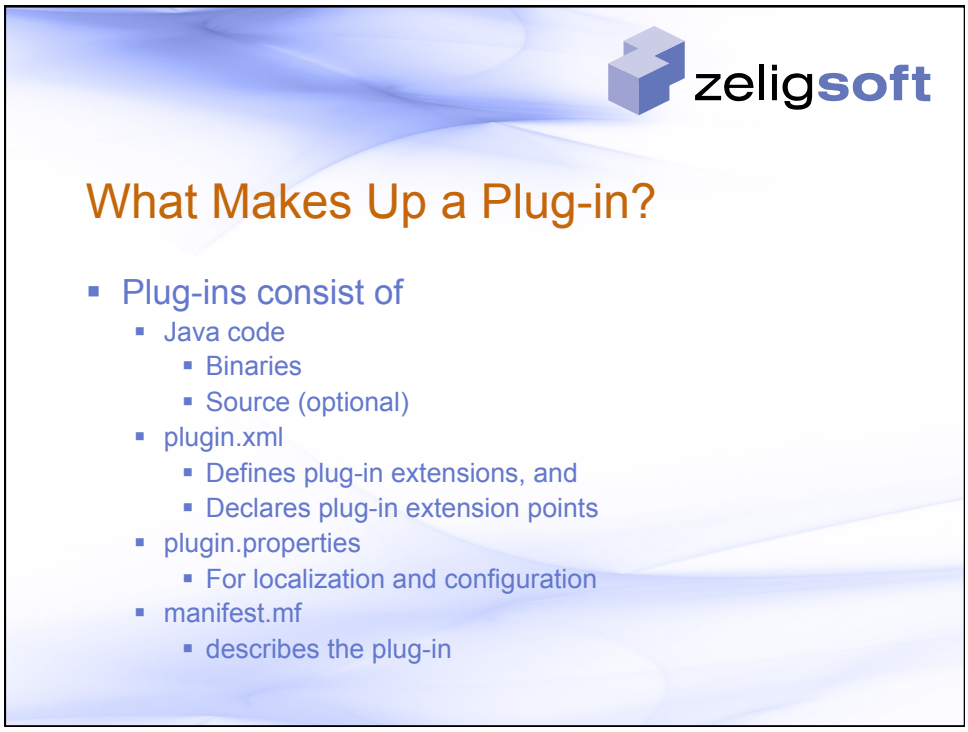
More Plug-ins
Plug-ins implement behavior defined through extension point API interface
Plug-in can extend
Named extension points
Extension points of other plug-ins
Plug-in can also declare an extension point and can provide an extension to it
Plug-ins are developed in the Java programming language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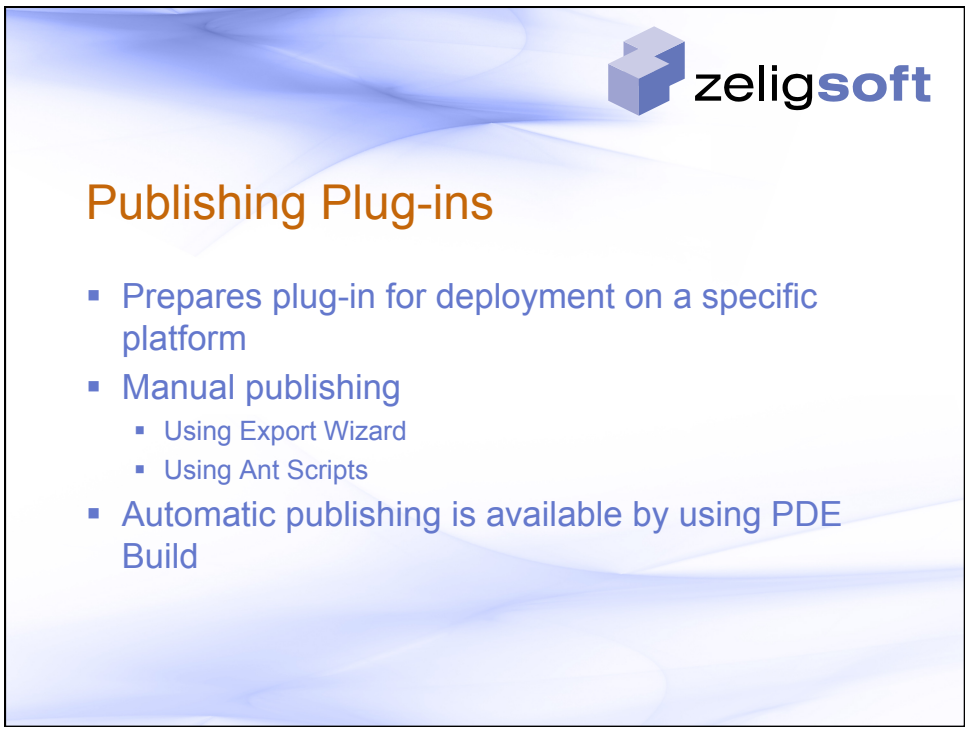
What Makes Up a Plug-in?
Plug-ins consist of
Java code
Binaries
Source (optional)
plugin.xml
Defines plug-in extensions, and
Declares plug-in extension points
plugin.properties
For localization and configuration
manifest.mf
describes the plug-in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Publishing Plug-ins
Prepares plug-in for deployment on a specific platform
Manual publishing
Using Export Wizard
Using Ant Scripts
Automatic publishing is available by using PDE Build

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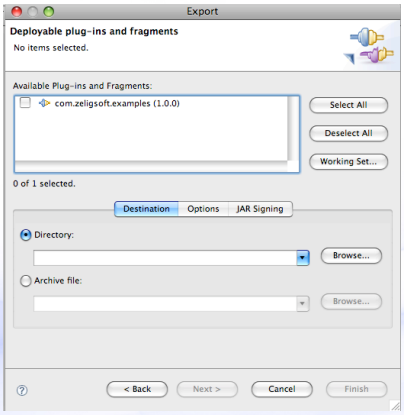
Manually Publishing a Plug-in

- A plug-in can be published manually by
  - **File → Export...**
  - Select Deployable plug-ins and fragments
  - Click **Next >** button
- Parameters configure how the plug-in published
- Can be saved as an Ant script



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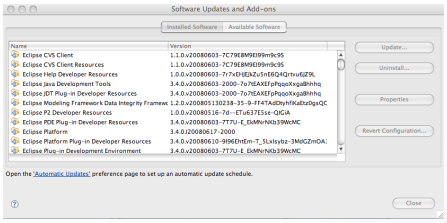
Installing Plug-ins

- Plug-ins are installed under \plugins\ directory of Eclipse installation
- Plug-ins can be installed from a update site
  - **Help → Software Updates..**
  - Typically as part of a feature
- Restart workbench



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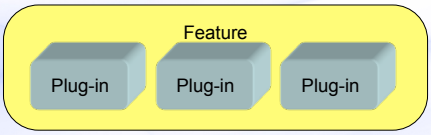
Features

- An Eclipse feature is a collection of plug-ins
  - Represents smallest unit of separately downloadable and installable functionality
- Installed into \features\ directory of Eclipse installation
- Features can be installed from an update site



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Product

- Stand-alone application built on Eclipse platform
- Typically include the JRE and Eclipse platform
- Defined by using an extension point
- Configurable
  - Splash screen
  - Default preference values
  - Welcome pages
- Customized installation


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Summary
In this module we explored
Eclipse architecture
Extension points
Plug-ins
Features
Products


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Agenda
What is Eclipse?
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The Eclipse Project
Plug-ins


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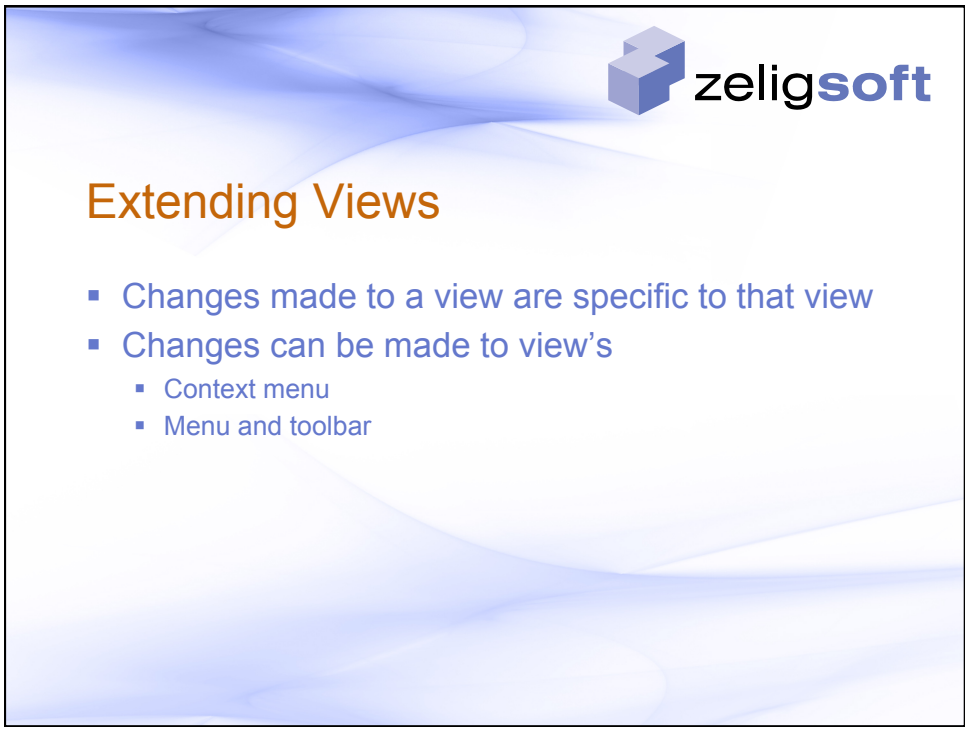
Integration Between Plug-ins
Supported through the ability to contribute actions to existing plug-ins
New plug-in contributes an action to existing plug-in
Allows for tight integration between plug-ins
There are many areas where actions can be contributed
Context menus and editors
Local toolbar and pull-down menu of a view
Toolbar and menu of an editor - appears on the Workbench when editor opens
Main toolbar and menu for the Workbench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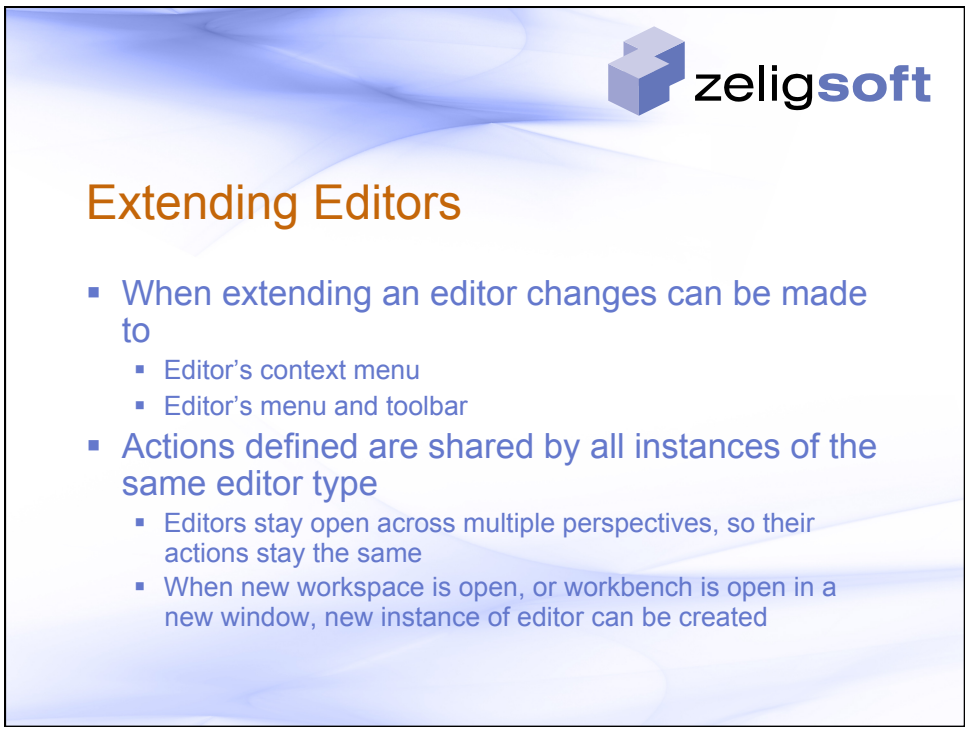
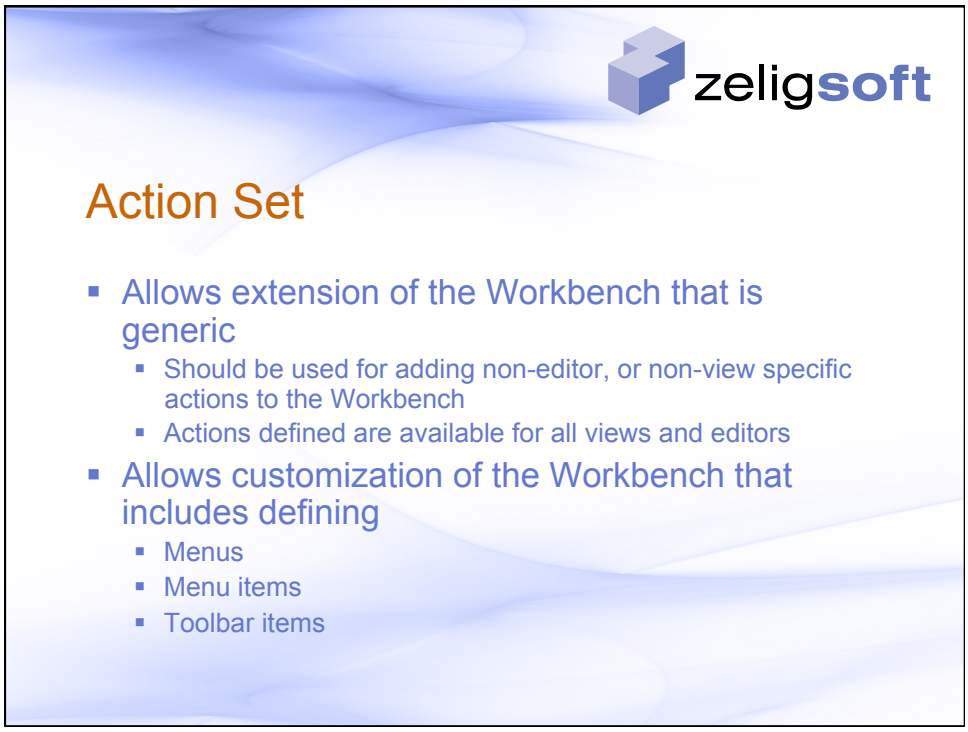
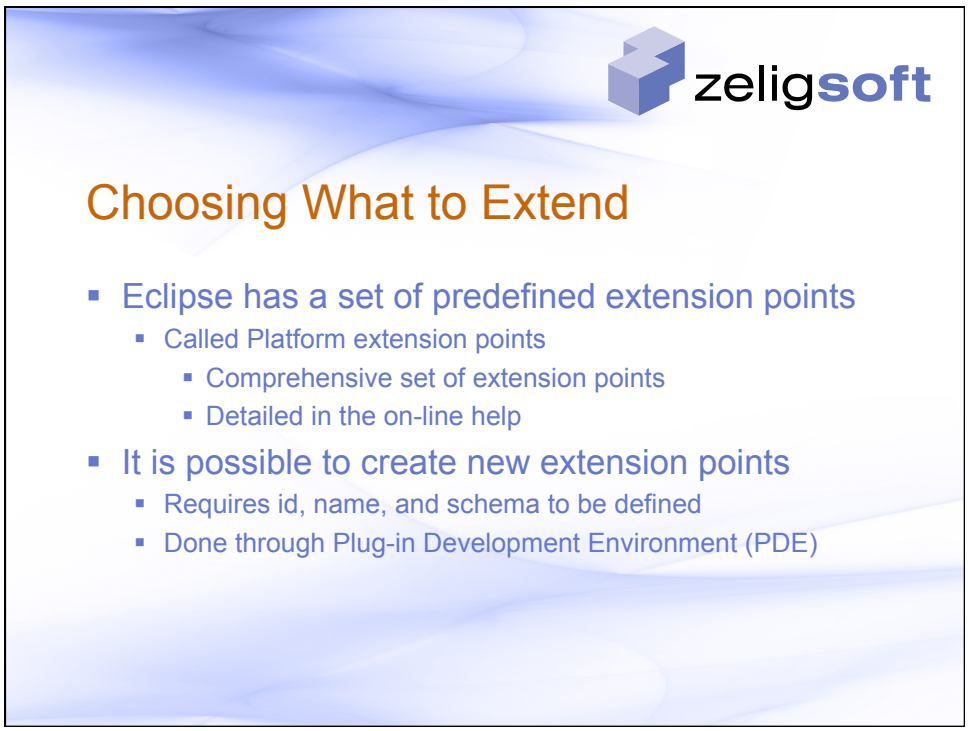
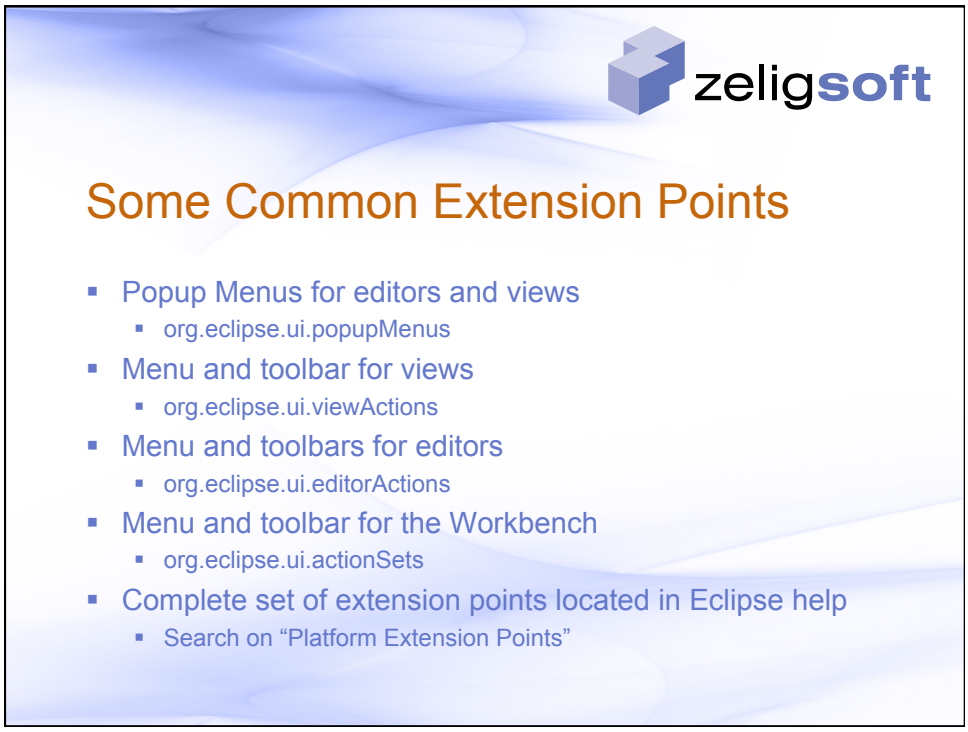
Extending Views
Changes made to a view are specific to that view
Changes can be made to view's
Context menu
Menu and toolbar


zeligsoft
Extending Editors
When extending an editor changes can be made to
Editor's context menu
Editor's menu and toolbar
Actions defined are shared by all instances of the same editor type
Editors stay open across multiple perspectives, so their actions stay the same
When new workspace is open, or workbench is open in a new window, new instance of editor can be created


zeligsoft
Action Set
Allows extension of the Workbench that is generic
Should be used for adding non-editor, or non-view specific actions to the Workbench
Actions defined are available for all views and editors
Allows customization of the Workbench that includes defining
Menus
Menu items
Toolbar items


zeligsoft
Choosing What to Extend
Eclipse has a set of predefined extension points
Called Platform extension points
Comprehensive set of extension points
Detailed in the on-line help
It is possible to create new extension points
Requires id, name, and schema to be defined
Done through Plug-in Development Environment (PDE)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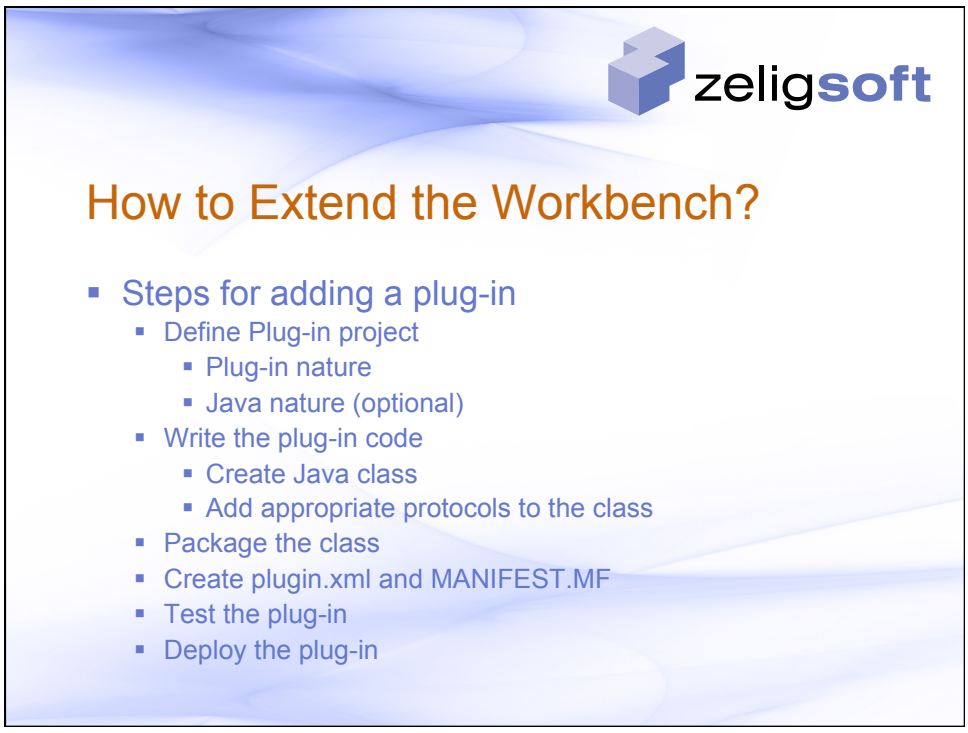
Some Common Extension Points
Popup Menus for editors and views
org.eclipse.ui.popupMenus
Menu and toolbar for views
org.eclipse.ui.viewActions
Menu and toolbars for editors
org.eclipse.ui.editorActions
Menu and toolbar for the Workbench
org.eclipse.ui.actionSets
Complete set of extension points located in Eclipse help
Search on “Platform Extension Points”


zeligsoft
How to Extend the Workbench?
Steps for adding a plug-in
Define Plug-in project
Plug-in nature
Java nature (optional)
Write the plug-in code
Create Java class
Add appropriate protocols to the class
Package the class
Create plugin.xml and MANIFEST.MF
Test the plug-in
Deploy the plug-in

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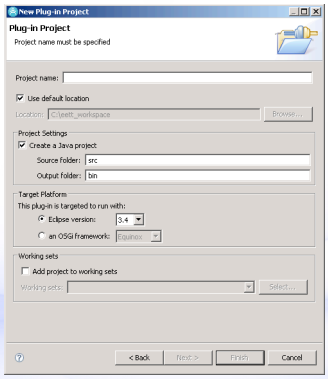
Creating Plug-in Project

- Plug-in project are created with the New Project wizard
  - File → New → Project…
- Project will contain
  - source code for the plug-in
  - manifest and property files



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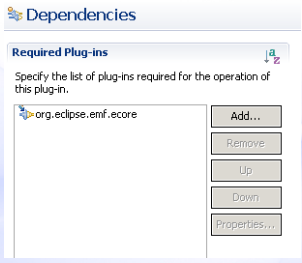
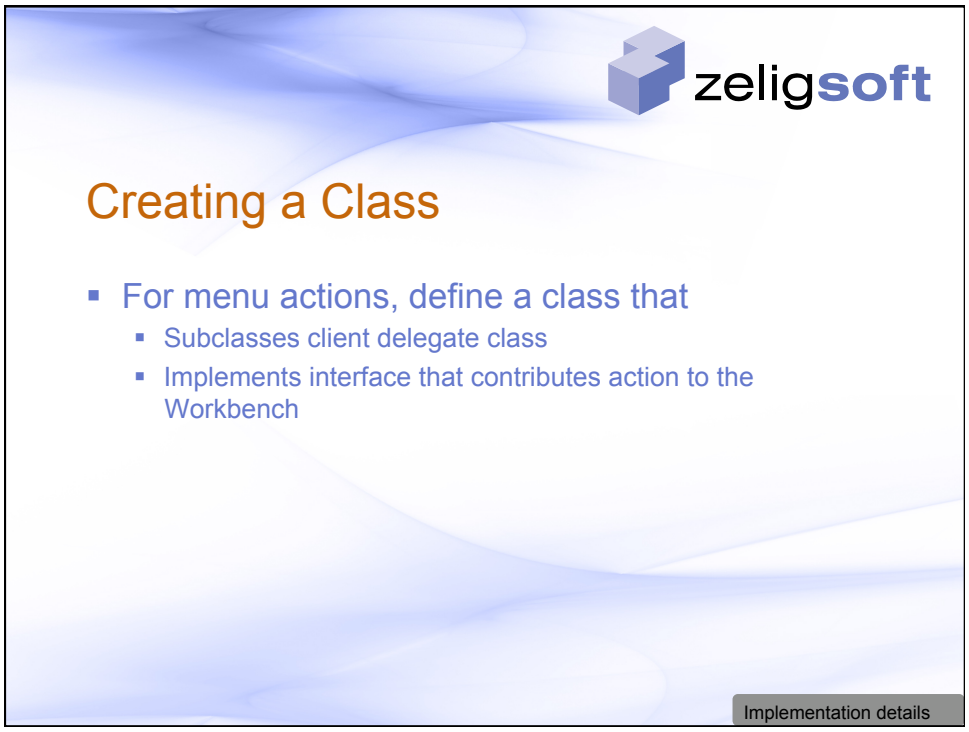
Updating Project's Dependencies

- To make classes required for the plug-in visible for the project, update its dependencies
  - You add a dependency on another plug-in
  - You can add a jar that is not part of a plug-in to the build path

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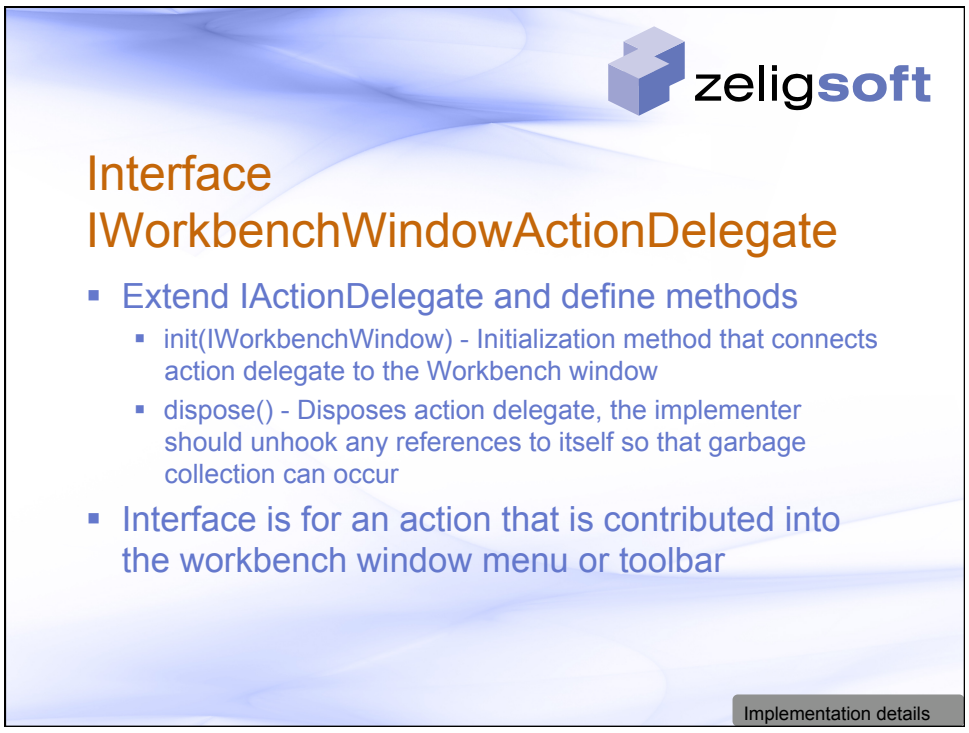
Creating a Class
For menu actions, define a class that
Subclasses client delegate class
Implements interface that contributes action to the Workbench
Implementation details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Interface IWorkbenchWindowActionDelegate
Extend IActionDelegate and define methods
init(IWorkbenchWindow) - Initialization method that connects action delegate to the Workbench window
dispose() - Disposes action delegate, the implementer should unhook any references to itself so that garbage collection can occur
Interface is for an action that is contributed into the workbench window menu or toolbar
Implementation details

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Class ActionDelegate

- Abstract base implementation for client delegate action (defines same methods as interface)
- In addition it also defines
  - runWithEvent(IAction, Event)
    - Does the actual work when action is triggered
    - Parameters represent the action proxy that handles the presentation portion of the action and the SWT event which triggered the action being run
    - Default implementation redirects to the run() method
  - run(IAction)
    - Inherited method, does the actual work as it's called when action is triggered
  - selectionChanged(IAction, ISelection)
    - Inherited method, notifies action delegate that the creation in the Workbench has changed

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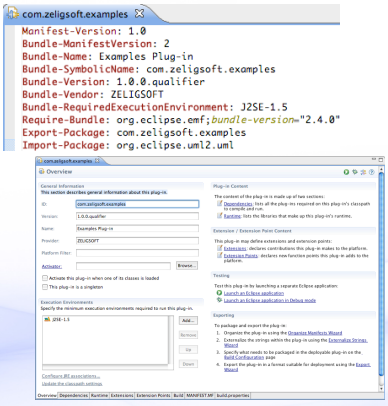
Defining Manifest

- MANIFEST.MF file
  - In the META-INF directory
- Defines
  - Plug-in name
  - Plug-in version
  - Plug-in vendor/provider
  - Plug-in dependencies
  - Packages exported
- Manifest editor available



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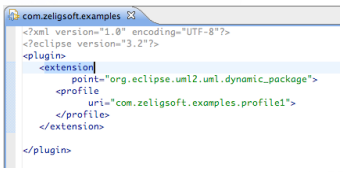
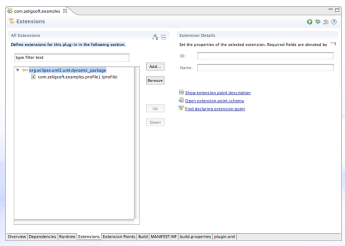
Defining plugin.xml

- In the root of the project
- Defines
  - Extensions
  - Extension points
- Extension editor
  - Includes wizards
- Extension point editor





Implementation details

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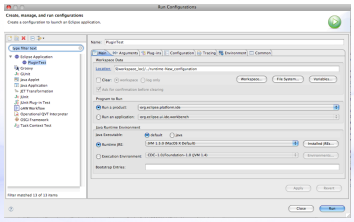
Testing Plug-in from Workbench

- Available by opening new Workbench instance
  - Run → Run As → Eclipse Application
- Used when developing plug-in within the platform
- Can be configured
  - Run → Run Configurations...
  - Eclipse Application
- Debug available
  - Run → Debug As → Eclipse Application



Implementation details

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Getting Ready to Export Plug-in

- Create a build.properties file in your project

```
source.. = src/
output.. = bin/
bin.includes = META-INF, \
               .,\
               plugin.xml, \
               plugin.properties
```

- Build properties editor available
  - Open with → Build Properties Editor

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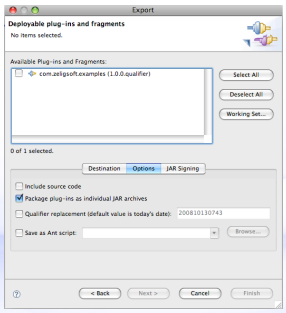
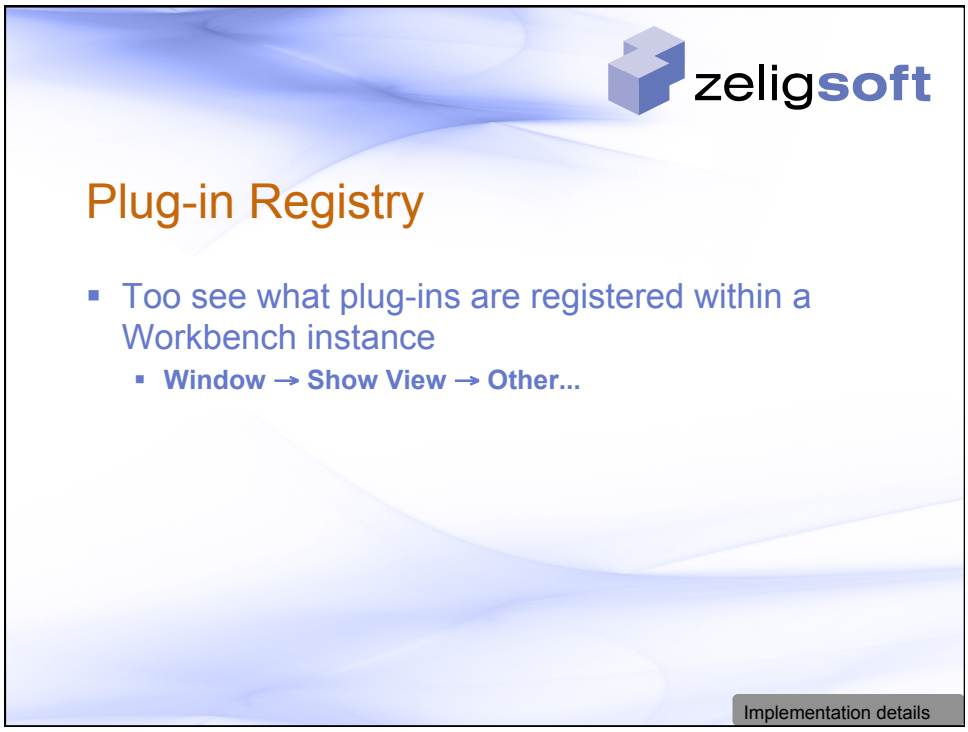
Exporting a Plug-in

- **File → Export...**
  - Deployable Plug-ins and Fragments
- Configure export
  - Archive vs. Directory
  - Packaging
  - Include source?
- Can save as ant script
- Ready to install

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Plug-in Registry
Too see what plug-ins are registered within a Workbench instance
Window → Show View → Other...
Implementation details


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Summary
In this module we explored
Plug-ins
MANIFEST
Plug-in descriptors
Testing plug-ins
Exporting plug-ins

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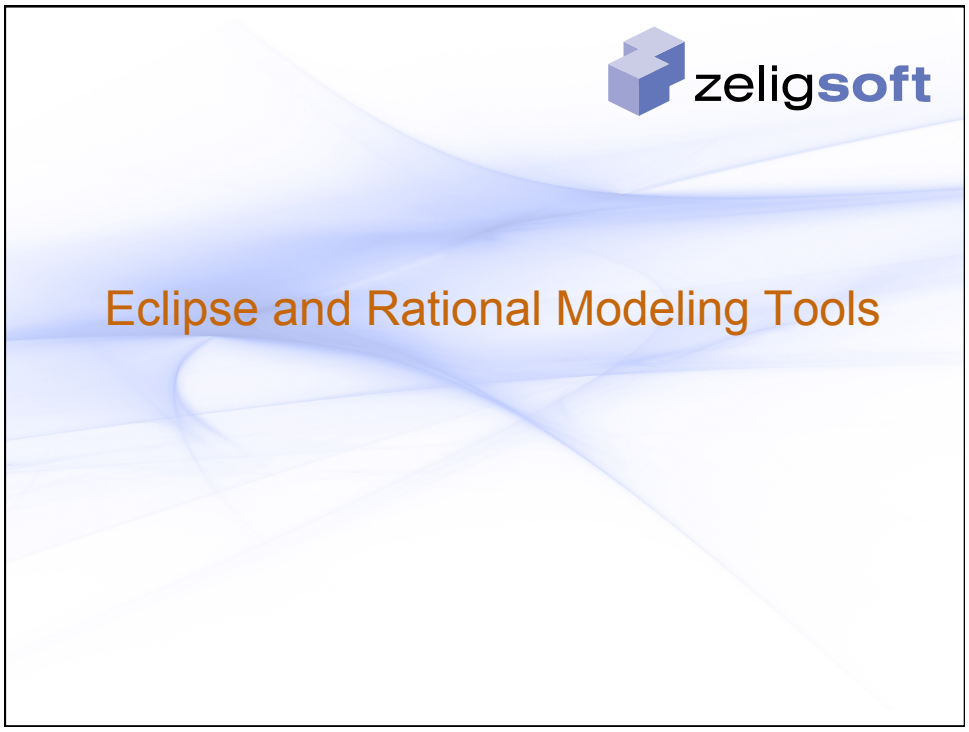
Questions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Eclipse and Rational Modeling Tools


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Overview
In this module we explore the eclipse modeling tools in more detail
Look at the different projects and how they relate


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Goals
After this module you will
Have an understanding of Eclipse modeling projects
How they extend each-other
How they can be transformed into models and text
You will also have a roadmap for the rest of the training


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Agenda
Modeling in Eclipse
EMF, GMF, TMF, TCS
Tooling in Eclipse
MDT, EMFT,
Transformations
M2M, M2T

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Eclipse Modeling Project

- Model-based development technologies
  - Frameworks
  - Tooling
  - Implementations of standards

eclipse modeling PROJECT

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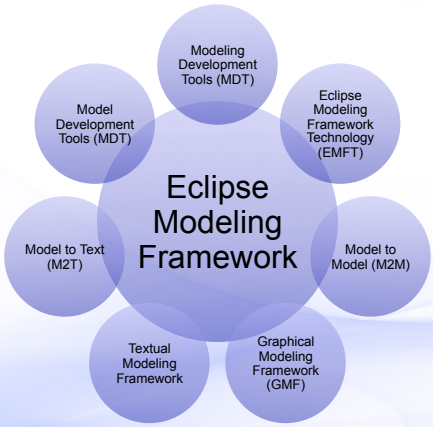
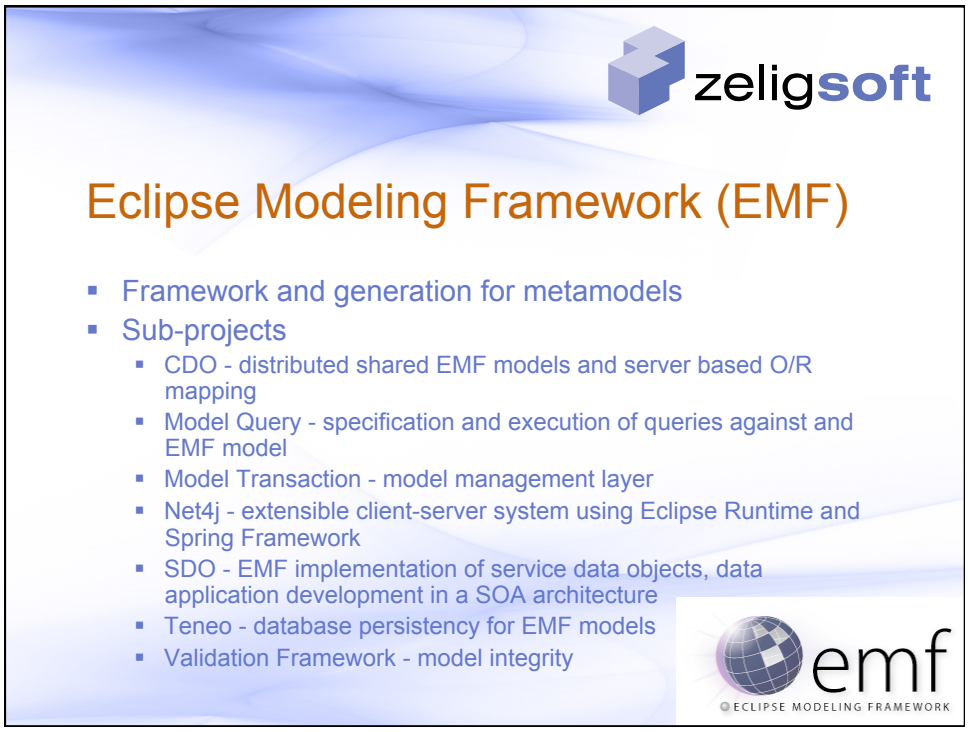
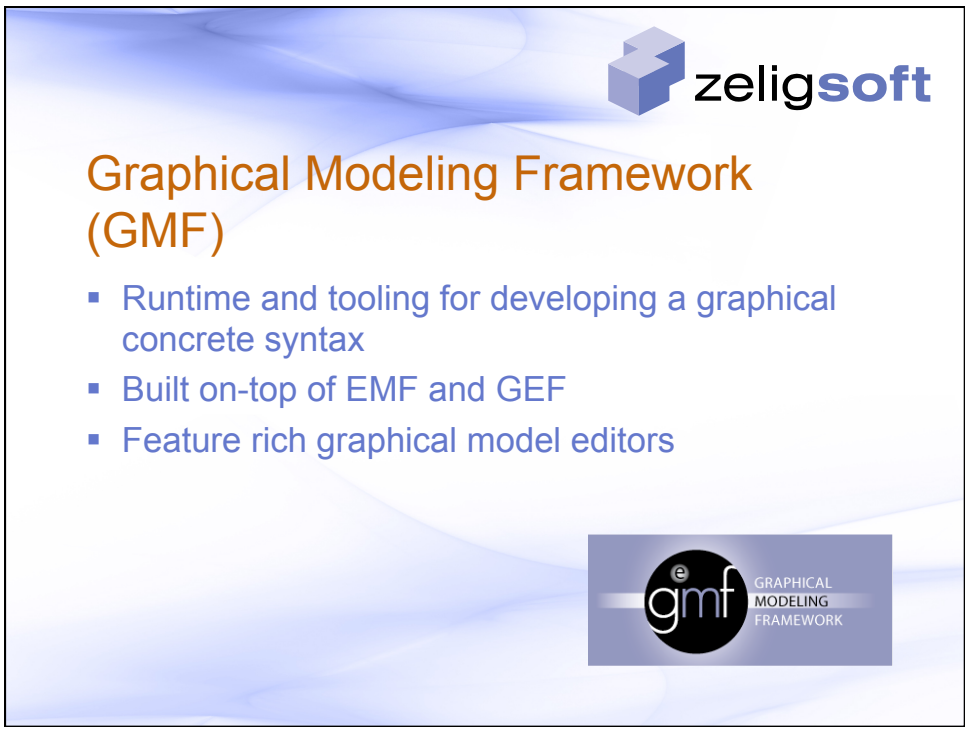
Ecosystem of the Modeling Project



Toby McClean, Zeligsoft, 2008





Toby McClean, Zeligsoft, 2008

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Textual Modeling Framework (TMF)

- Runtime and tooling for developing textual concrete syntax
- Generation of editors and other tooling from a grammar
- Sub-projects
  - TCS
  - xtext

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TMF - TCS

- TCS - Textual Concrete Syntax
- Built on top of EMF
- Non-standards based language for annotating an abstract syntax model with textual syntax
- Able to generate
  - Grammar
  - Editor
  - Model to text transformation with traceability

Toby McClean, Zeligsoft, 2008

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TMF - xtext

- Developed as part of the openArchitectureWare
- Built on-top of EMF and ANTLr
- From proprietary grammar language
  - Generate editor - syntax highlighting and code completion
  - Generate EMF abstract syntax model
  - Generate integration with generation framework
  - Generate integration with semantic validation framework

xtext

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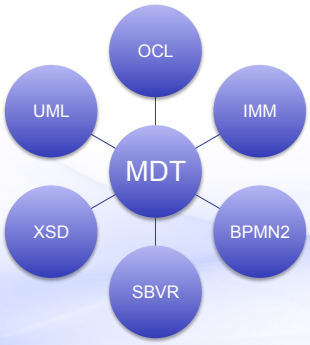
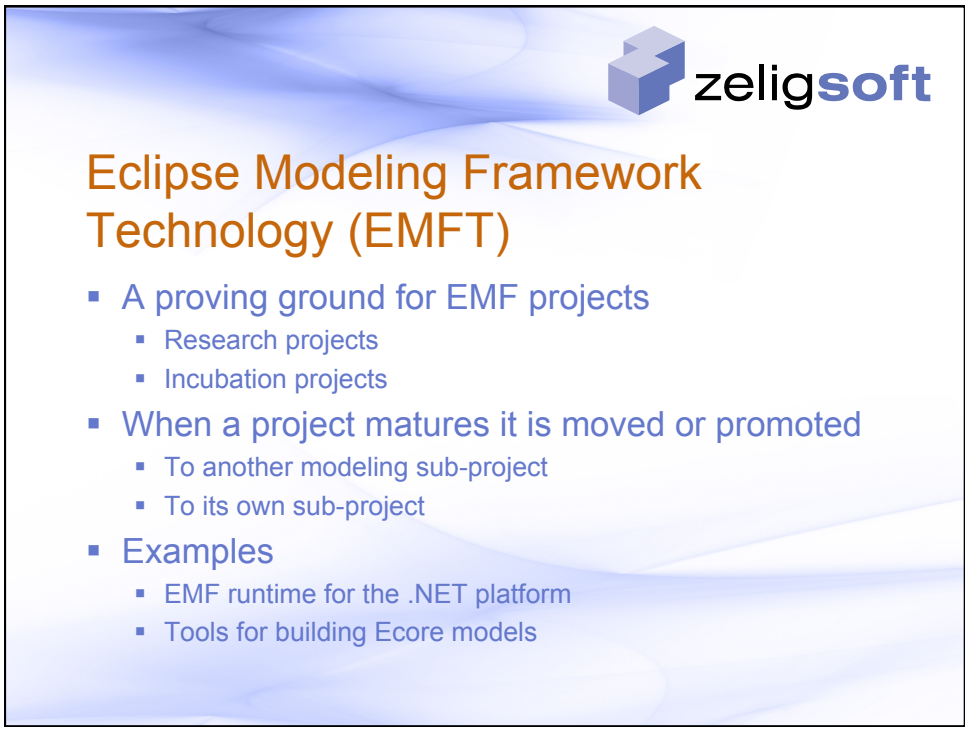
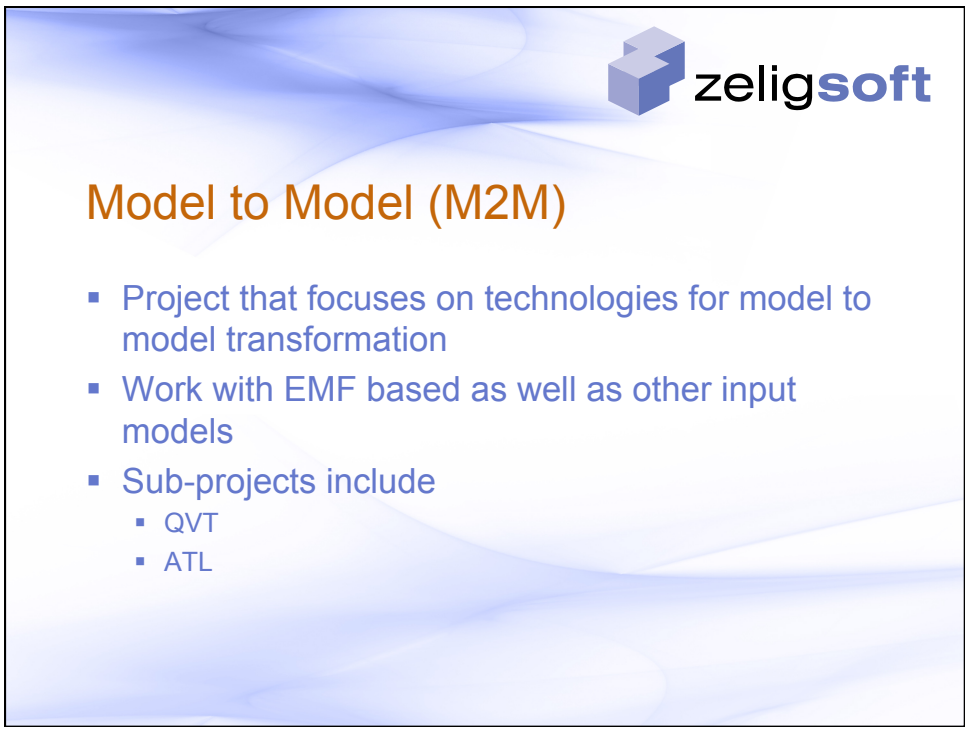
Model Development Tools (MDT)

- Project that focuses on industry stand models



Toby McClean, Zeligsoft, 2008





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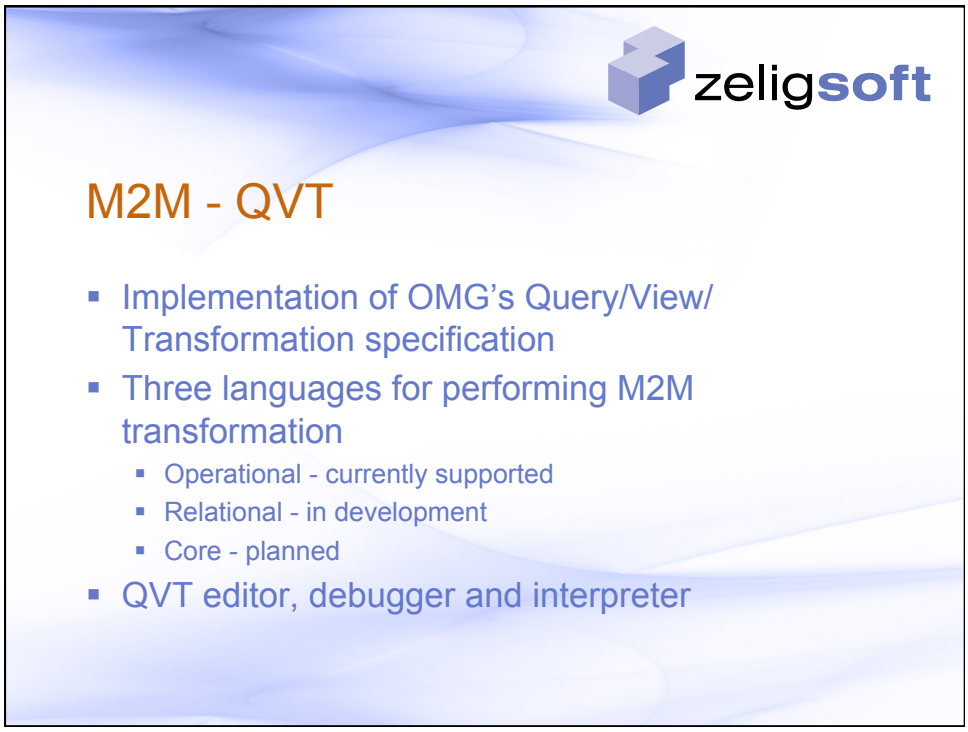
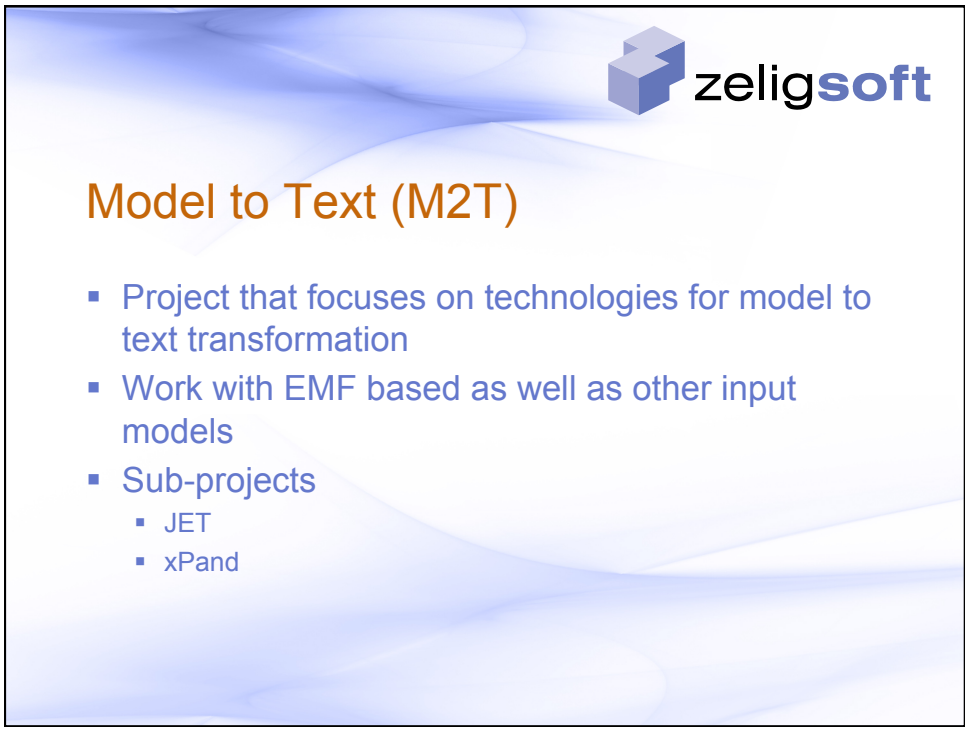


Toby McClean, Zeligsoft, 2008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Model to Text (M2T)
Project that focuses on technologies for model to text transformation
Work with EMF based as well as other input models
Sub-projects
JET
xPand


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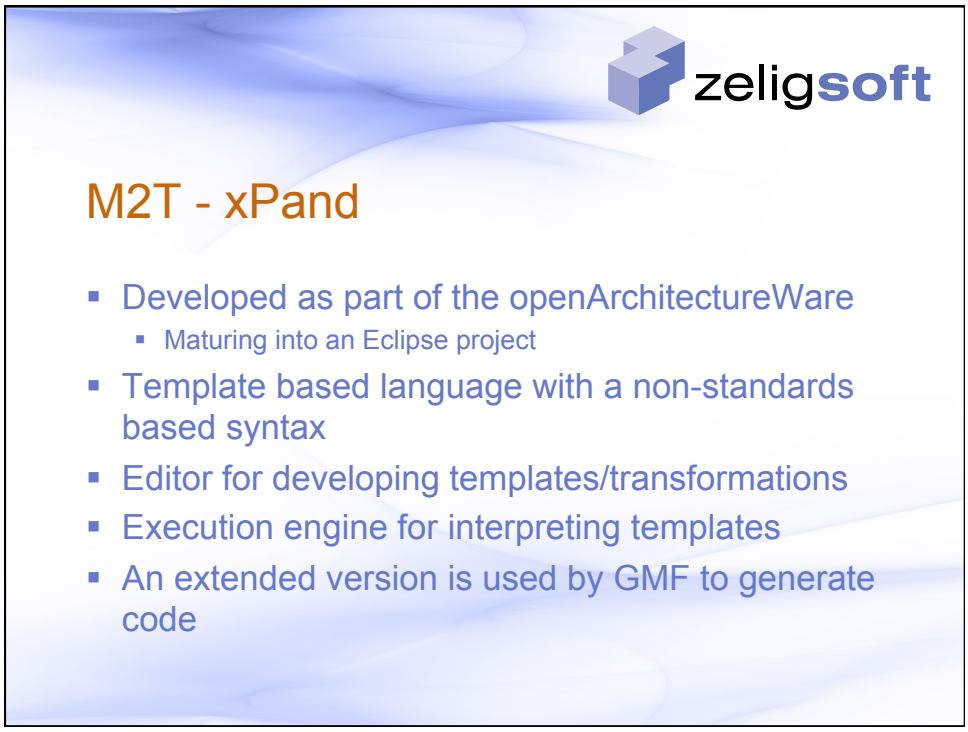
M2T- JET
JET - Java Emitter Templates
Template based language with an JSP like syntax
Editor for developing templates/transformations
Execution engine for executing transformation
Used by EMF to generate code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M2T - xPand
Developed as part of the openArchitectureWare
Maturing into an Eclipse project
Template based language with a non-standards based syntax
Editor for developing templates/transformations
Execution engine for interpreting templates
An extended version is used by GMF to generate code


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Summary
The projects are nicely layered
Good effort to keep things separated
Ability for users to pick and choose what they want
Lots of content to go through this week

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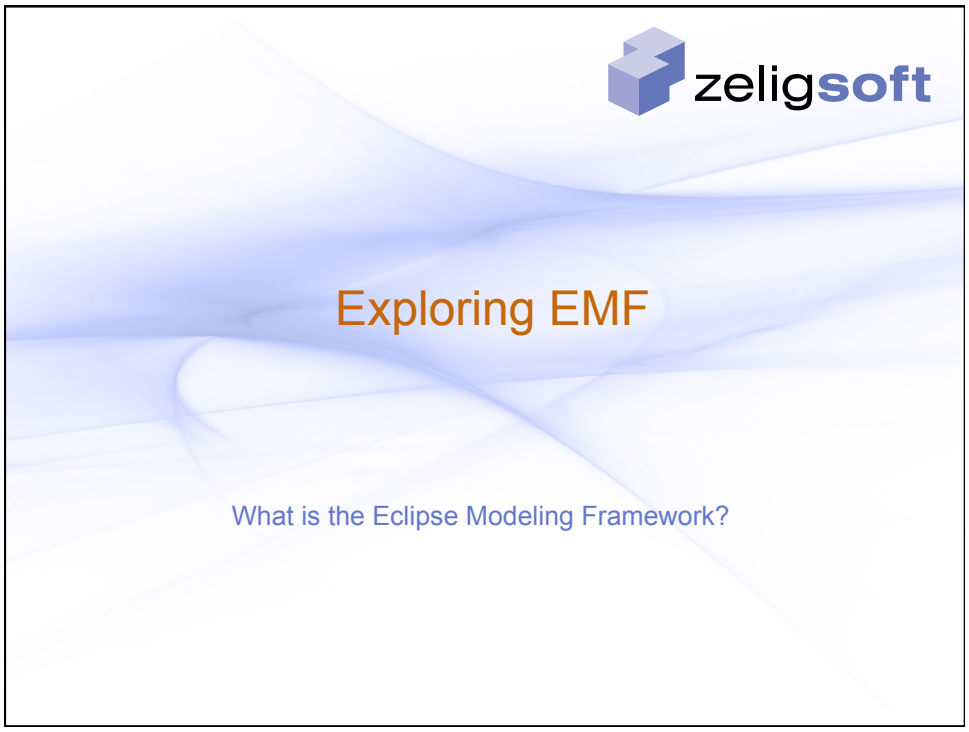
Questions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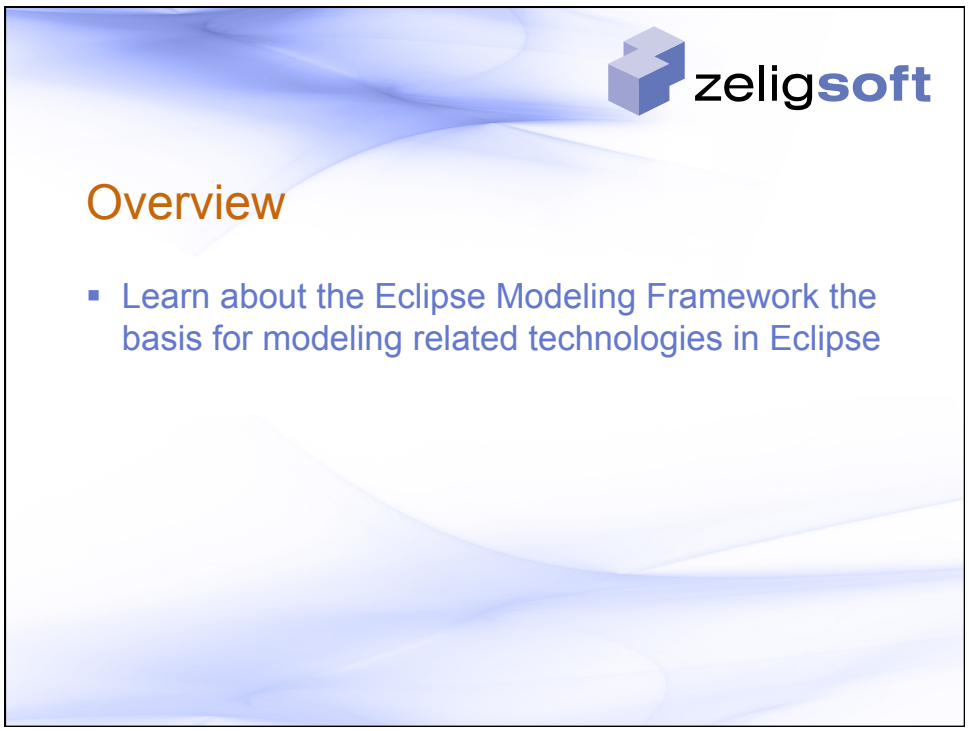
Exploring EMF
What is the Eclipse Modeling Framework?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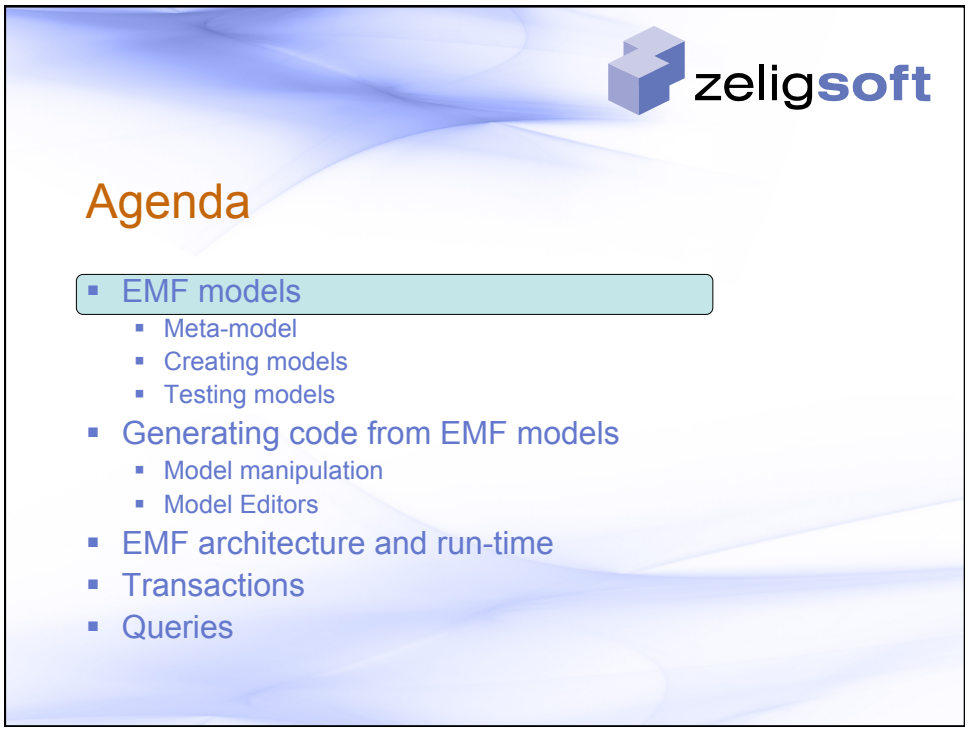
Overview
Learn about the Eclipse Modeling Framework the basis for modeling related technologies in Eclipse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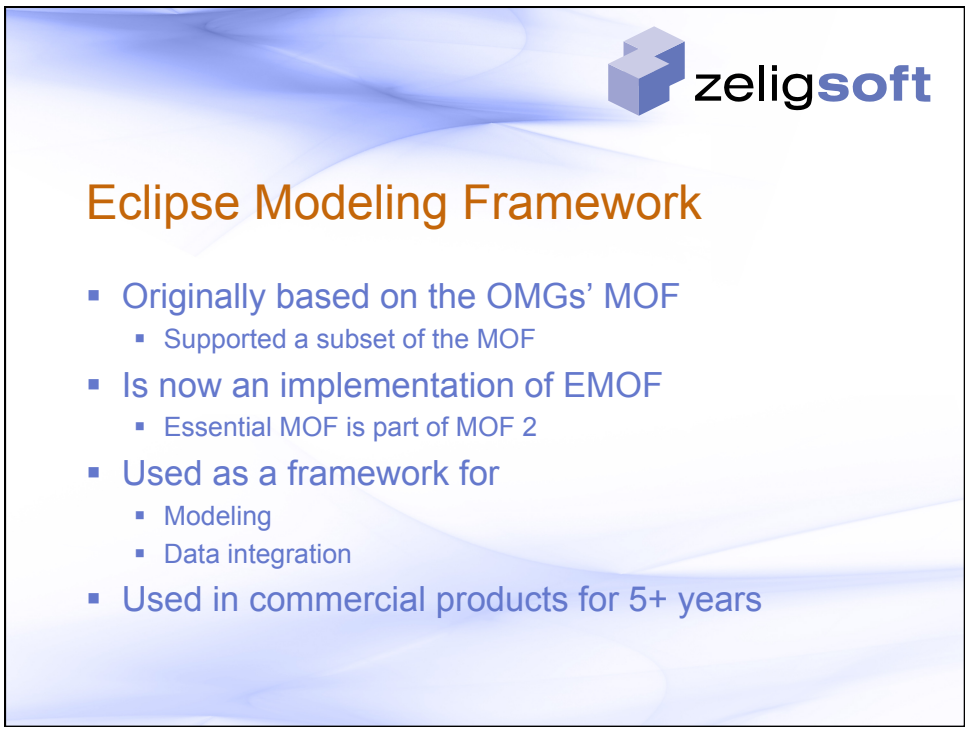
Agenda
EMF models
Meta-model
Creating models
Testing models
Generating code from EMF models
Model manipulation
Model Editors
EMF architecture and run-time
Transactions
Queries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Eclipse Modeling Framework
Originally based on the OMGs' MOF
Supported a subset of the MOF
Is now an implementation of EMOF
Essential MOF is part of MOF 2
Used as a framework for
Modeling
Data integration
Used in commercial products for 5+ years

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What is an EMF Model?

- Description of data for a domain/application
  - The attributes and capabilities of domain concepts
  - Relationships between the domain concepts
  - Cardinalities of attributes and relationships
- It defines the *metamodel* or abstract syntax for your domain
- Defined in the Ecore modeling language

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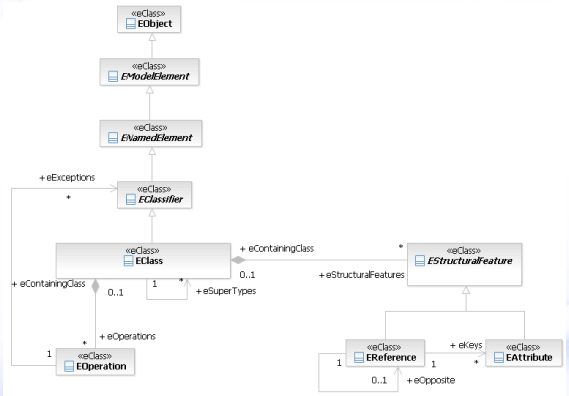
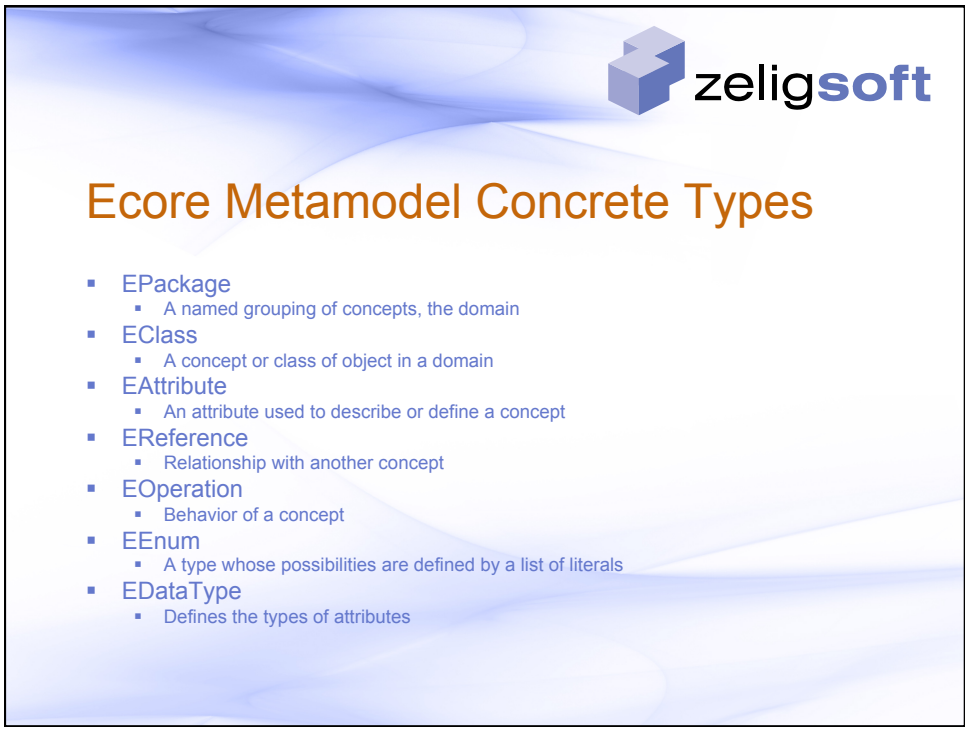
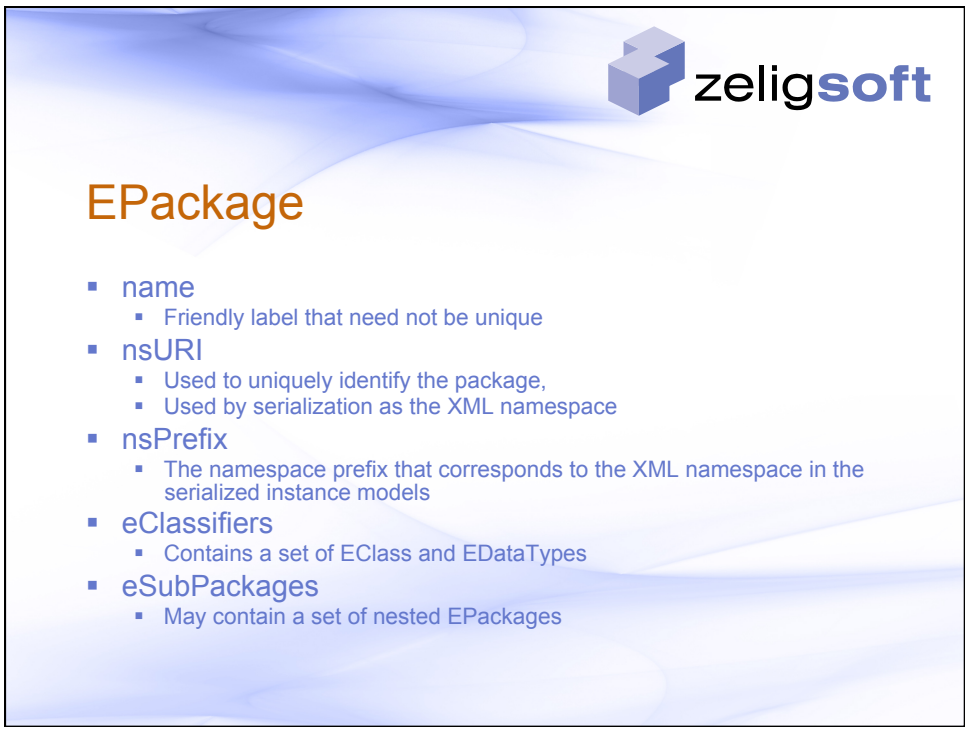
The Ecore Metamodel

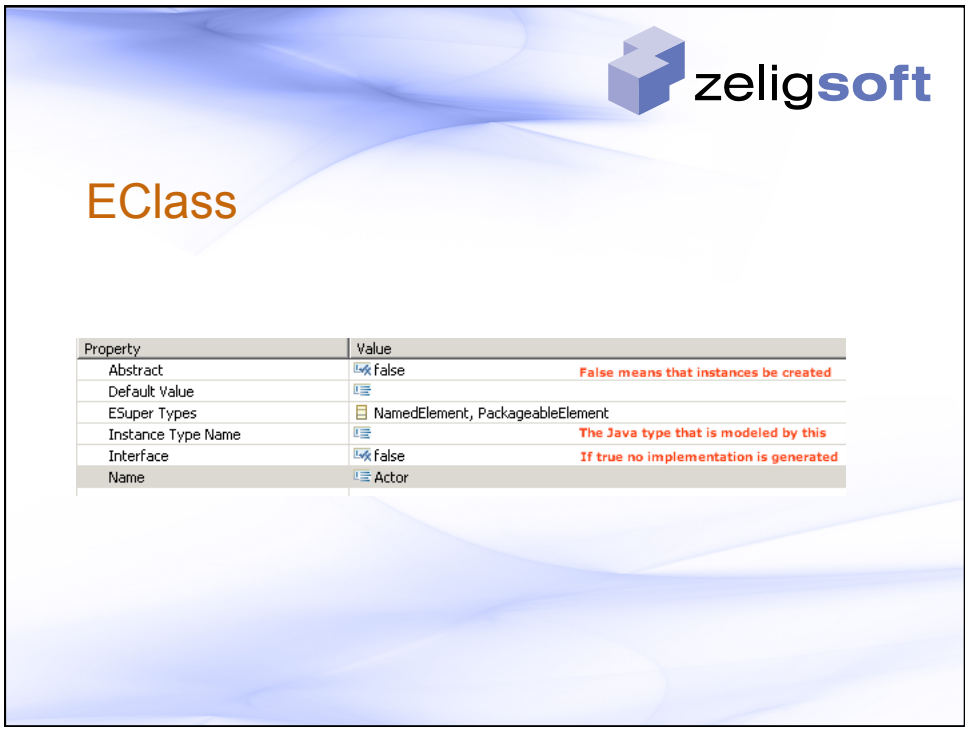


Toby McClean, Zeligsoft, 2008





Toby McClean, Zeligsoft, 2008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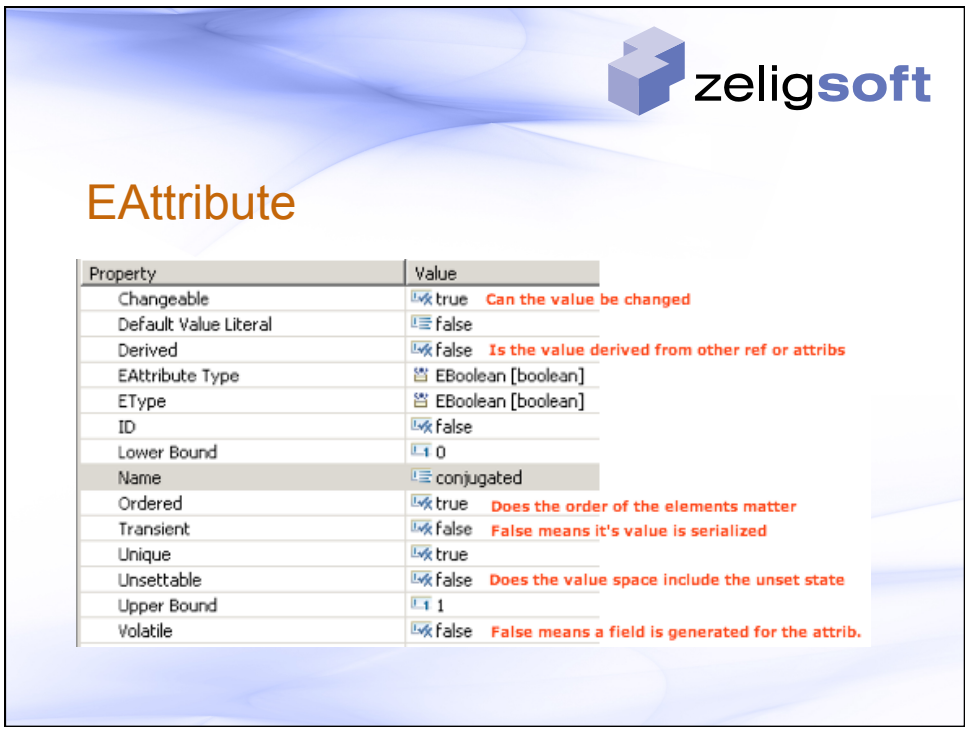
EClass
Property
Value
Abstract
false
False means that instances be created
Default Value
ESuper Types
NamedElement, PackageableElement
Instance Type Name
The Java type that is modeled by this
Interface
false
If true no implementation is generated
Name
Actor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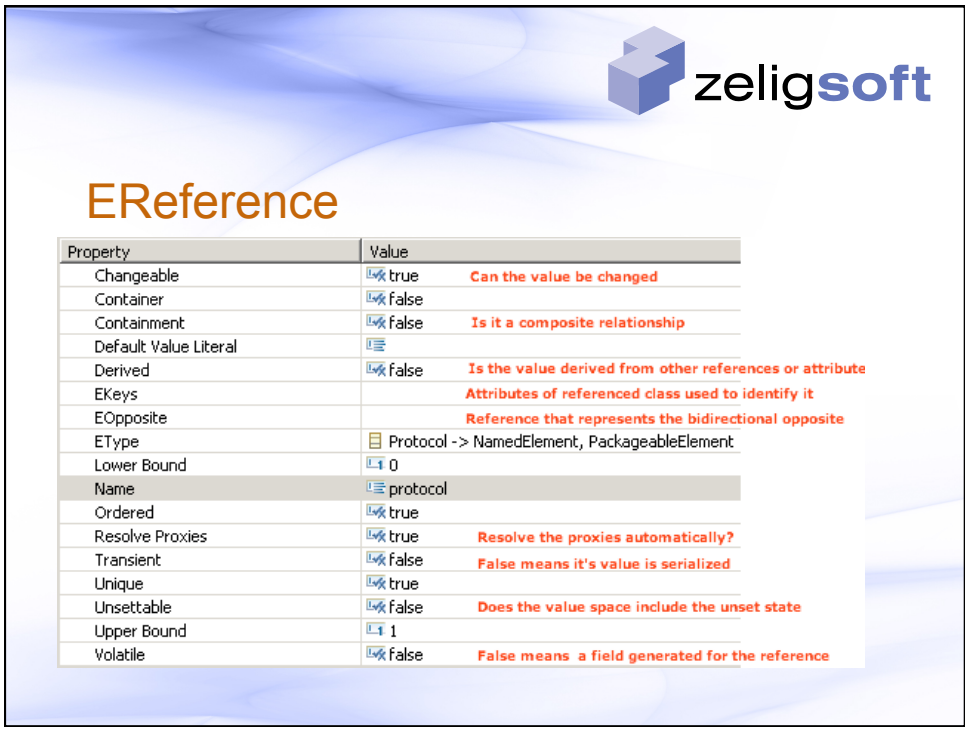
EAttribute
Property
Value
Changeable
true
Can the value be changed
Default Value Literal
false
Derived
false
Is the value derived from other ref or attribs
EAttribute Type
EBoolean [boolean]
EType
EBoolean [boolean]
ID
false
Lower Bound
0
Name
conjugated
Ordered
true
Does the order of the elements matter
Transient
false
False means it's value is serialized
Unique
true
Unsettable
false
Does the value space include the unset state
Upper Bound
1
Volatile
false
False means a field is generated for the attrib.



Toby McClean, Zeligsoft, 2008

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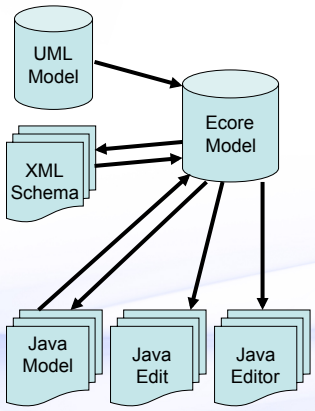
Creating an EMF Model

- EMF models can be created from
  - Java Interfaces
  - UML Class diagram
  - XML Schema
  - Ecore Diagram Editor
- With EMF if you have one of the above then you can generate the others
- Supports both
  - EMFizing a legacy data model
  - Greenfields development



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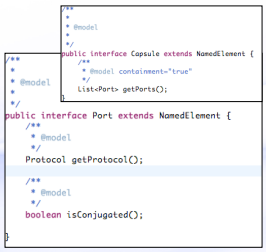
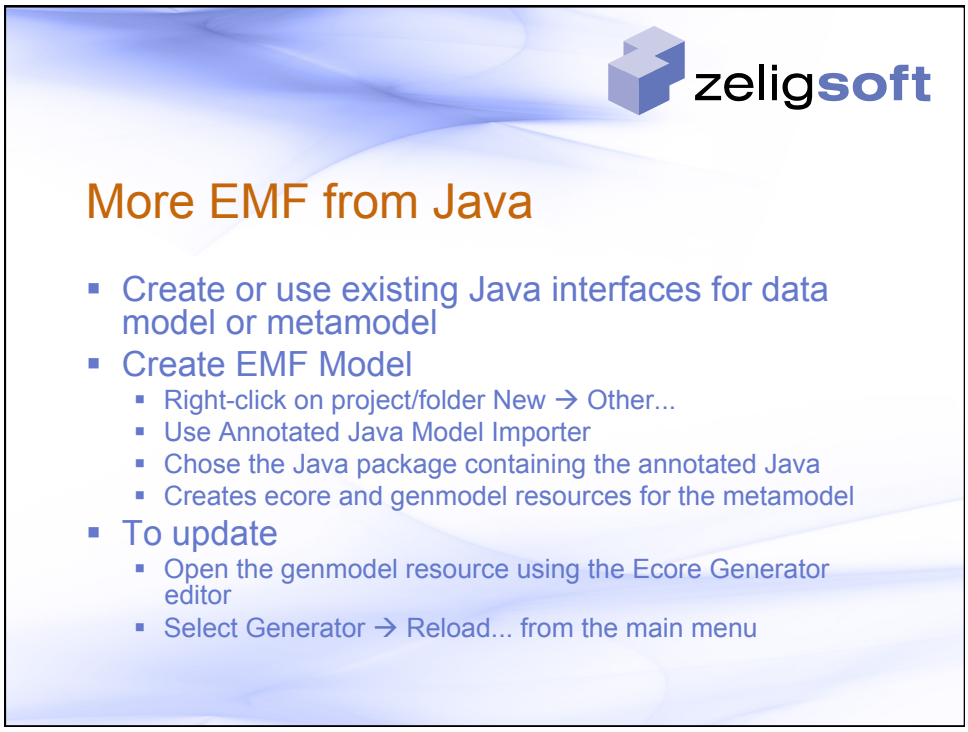
EMF from Java

- EMF models can be created from annotated Java
  - Typically for EMFizing legacy software
- @model annotation indicates parts of the code that correspond to model elements
  - interface - creates a class in EMF
  - method - creates operation in EMF
  - get method - creates attribute in EMF
- Supports reloading
  - i.e. can update the model by editing Java

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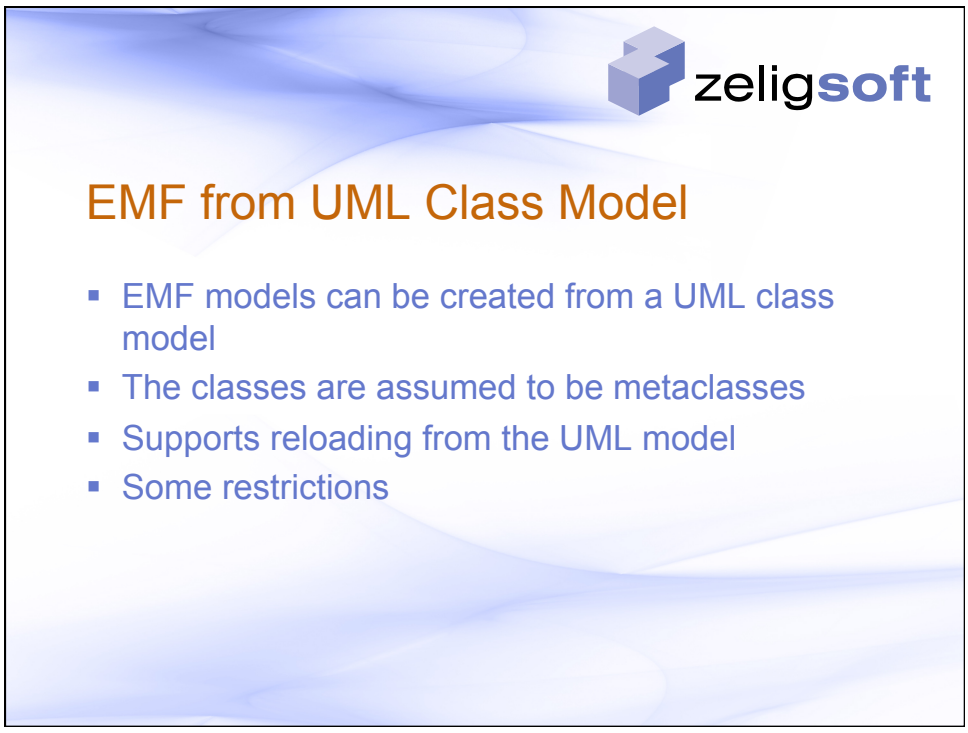
More EMF from Java
Create or use existing Java interfaces for data model or metamodel
Create EMF Model
Right-click on project/folder New → Other...
Use Annotated Java Model Importer
Chose the Java package containing the annotated Java
Creates ecore and genmodel resources for the metamodel
To update
Open the genmodel resource using the Ecore Generator editor
Select Generator → Reload... from the main menu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EMF from UML Class Model
EMF models can be created from a UML class model
The classes are assumed to be metaclasses
Supports reloading from the UML model
Some restrictions

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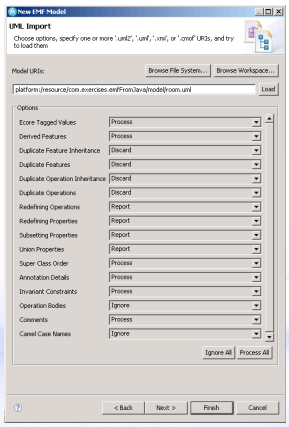
More EMF from UML Class Model

- Create UML model
- Create EMF model
  - New → Other...
  - Use UML Model Importer
  - Chose the UML model
  - Configure import
  - Creates ecore and genmodel resources for the metamodel
- To update
  - Open the genmodel resource using the Ecore Generator Editor
  - Select Generator → Reload...



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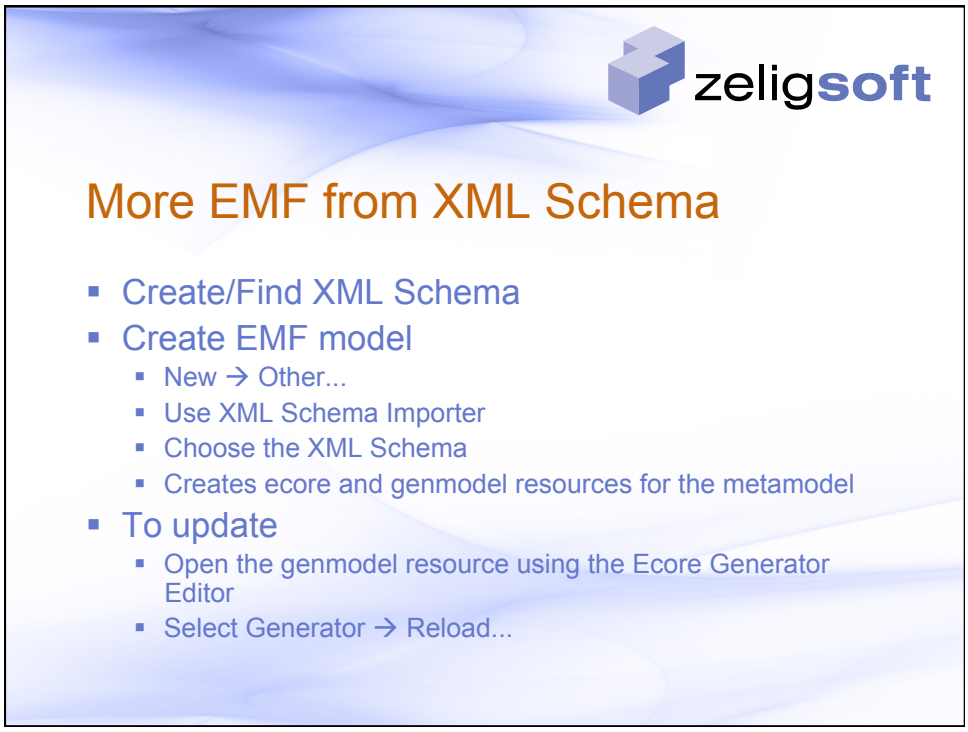
EMF from XML Schema

- Many industry standards produce XML schemas to define their data format
- EMF model can be created from an XML schema
  - Model instances are schema compliant
- Supports reloading from XML schema
- Schema can be regenerated from EMF model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More EMF from XML Schema
Create/Find XML Schema
Create EMF model
New → Other...
Use XML Schema Importer
Choose the XML Schema
Creates ecore and genmodel resources for the metamodel
To update
Open the genmodel resource using the Ecore Generator Editor
Select Generator → Reload...


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EMF with Ecore Diagram Editor
The Ecore Diagram Editor provides a Class diagram like editor for graphically modeling
Built on top of the GMF framework
Editor is canonical
One diagram per EMF model
Creates model and diagram resources
File → New → Other...
Ecore Diagram

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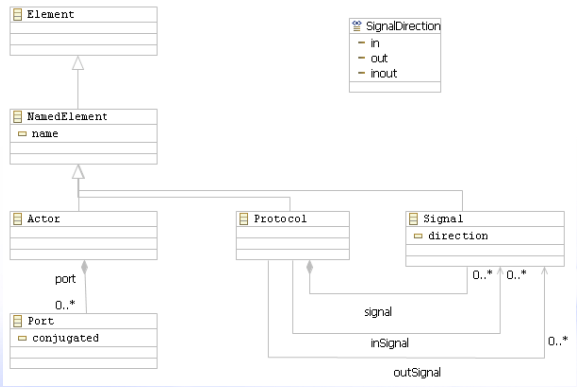
More EMF with Ecore Diagram Editor



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How do I Test my Model?

- Manually review the model and ensure that it looks like it will work!
  - Error prone
- Build the generation model now generate the default model editor
  - Time consuming when frequently changing
- Use the dynamic instance creation capabilities
  - Part of the Sample Ecore Model Editor
- Use the generated test suite from EMF
  - Generates a JUnit test suite, to test the user supplied code in operations and derived features

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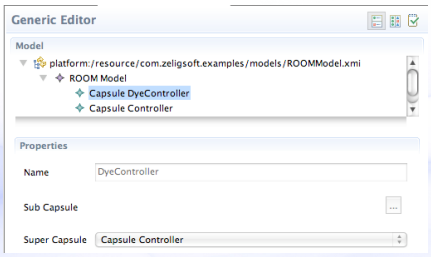
Dynamically Creating Models

- While developing a model it can be tested by creating dynamic instance
  - Does not require anything to be generated
  - Does not require a runtime workbench
  - Uses reflective capabilities of EMF
- In the Ecore editor
  - Right-click on the EClass
  - Create Dynamic Instance...
- Stored as XMI



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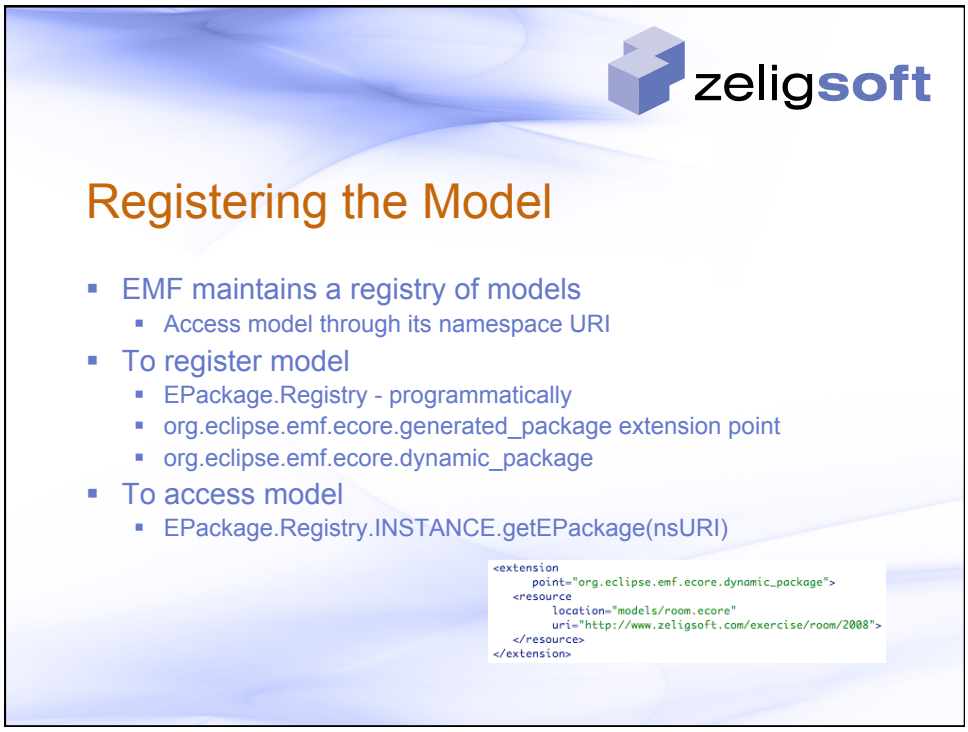
Do this with Code?

- Register the ecore model as a dynamic package
- Use the reflective API of EMF
  - Can create instances and persist them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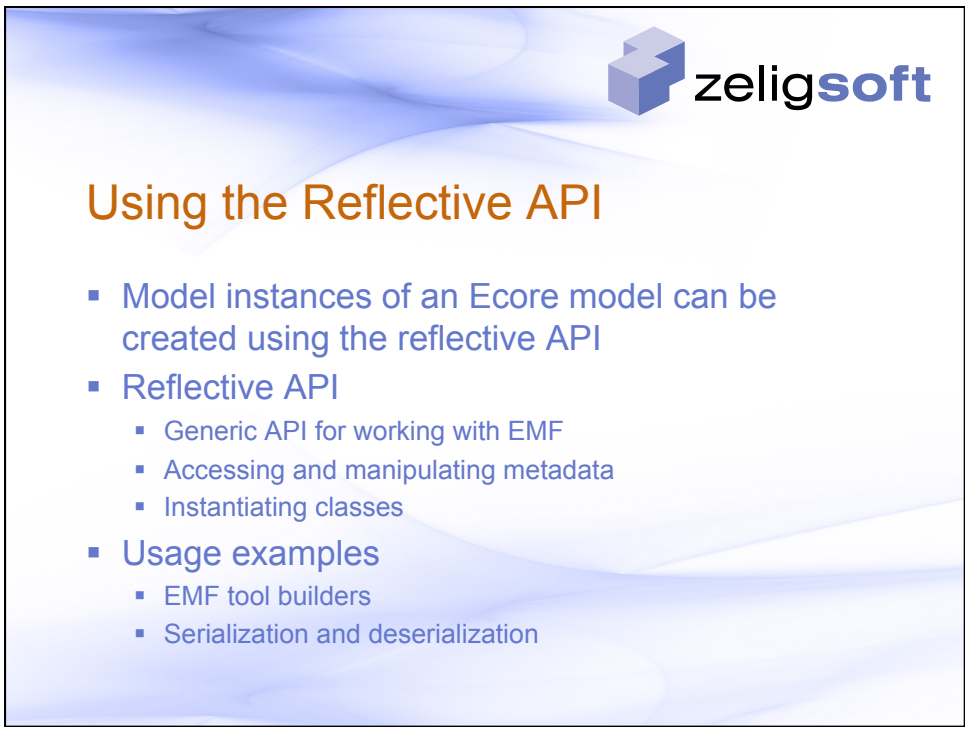
Registering the Model
EMF maintains a registry of models
Access model through its namespace URI
To register model
EPackage.Registry - programmatically
org.eclipse.emf.ecore.generated_package extension point
org.eclipse.emf.ecore.dynamic_package
To access model
EPackage.Registry.INSTANCE.getEPackage(nsURI)
<extension
point="org.eclipse.emf.ecore.dynamic_package">
<resource
location="models/room.ecore"
uri="http://www.zeligsoft.com/exercise/room/2008">
</resource>
</extension>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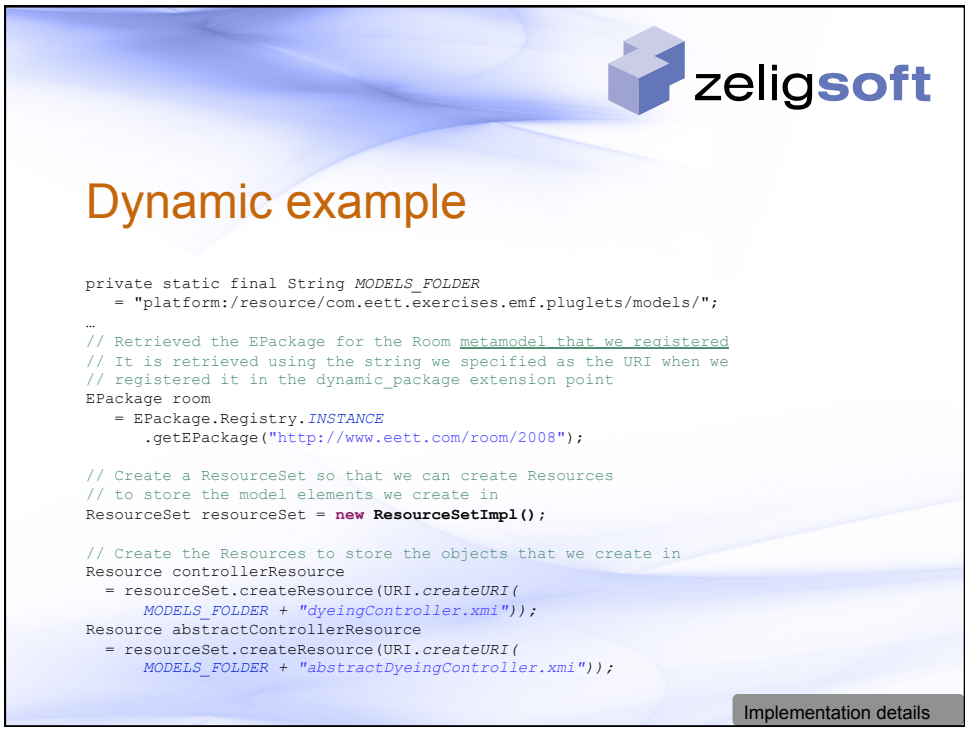
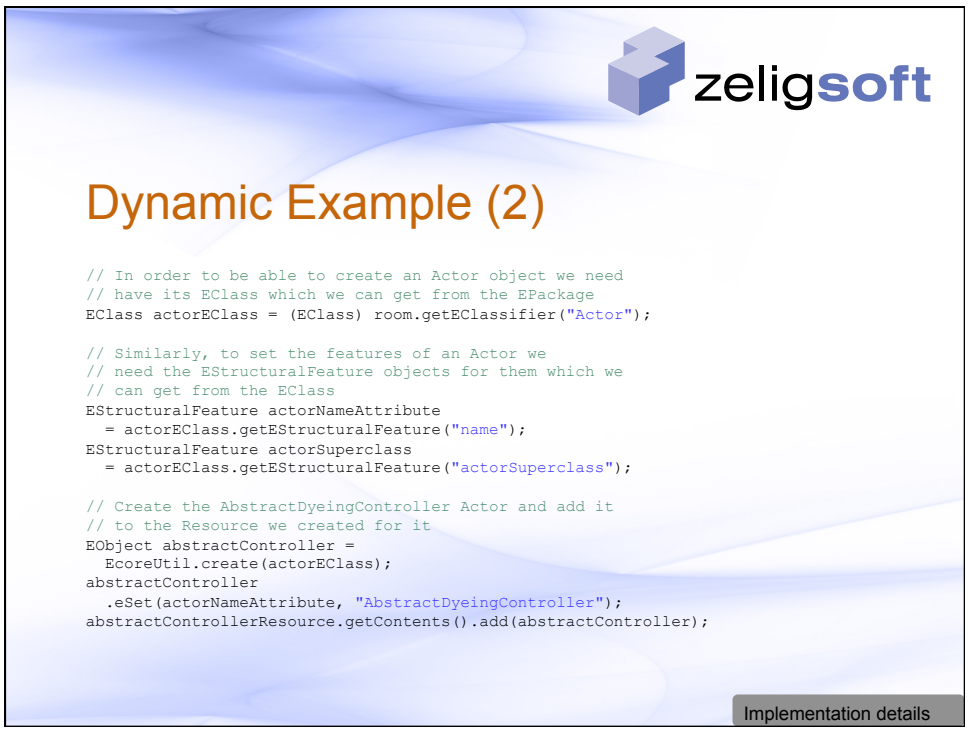
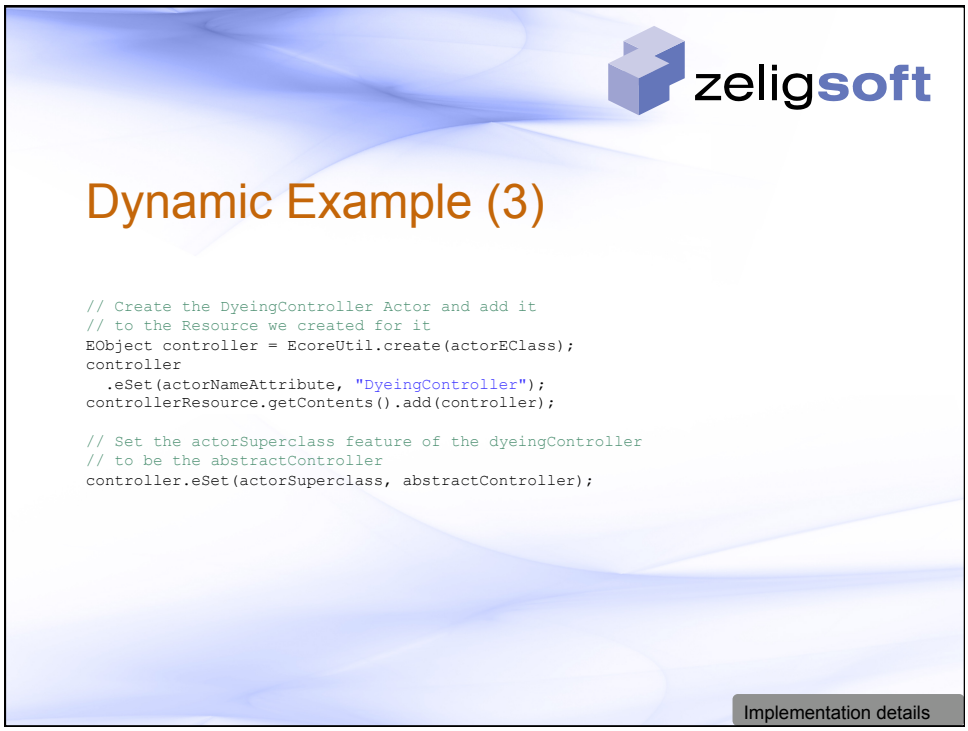
Using the Reflective API
Model instances of an Ecore model can be created using the reflective API
Reflective API
Generic API for working with EMF
Accessing and manipulating metadata
Instantiating classes
Usage examples
EMF tool builders
Serialization and deserialization





Toby McClean, Zeligsoft, 2008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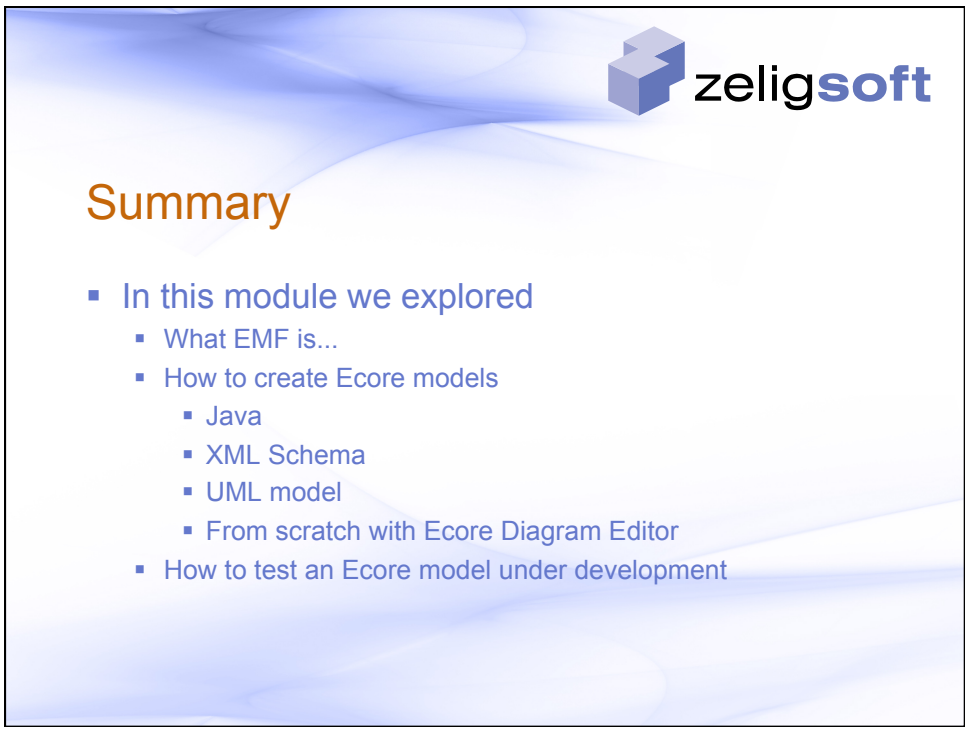
Dynamic Example (3)
// Create the DyeingController Actor and add it
// to the Resource we created for it
EObject controller = EcoreUtil.create(actorEClass);
controller
.eSet(actorNameAttribute, "DyeingController");
controllerResource.getContents().add(controller);
// Set the actorSuperclass feature of the dyeingController
// to be the abstractController
controller.eSet(actorSuperclass, abstractController);
Implementation details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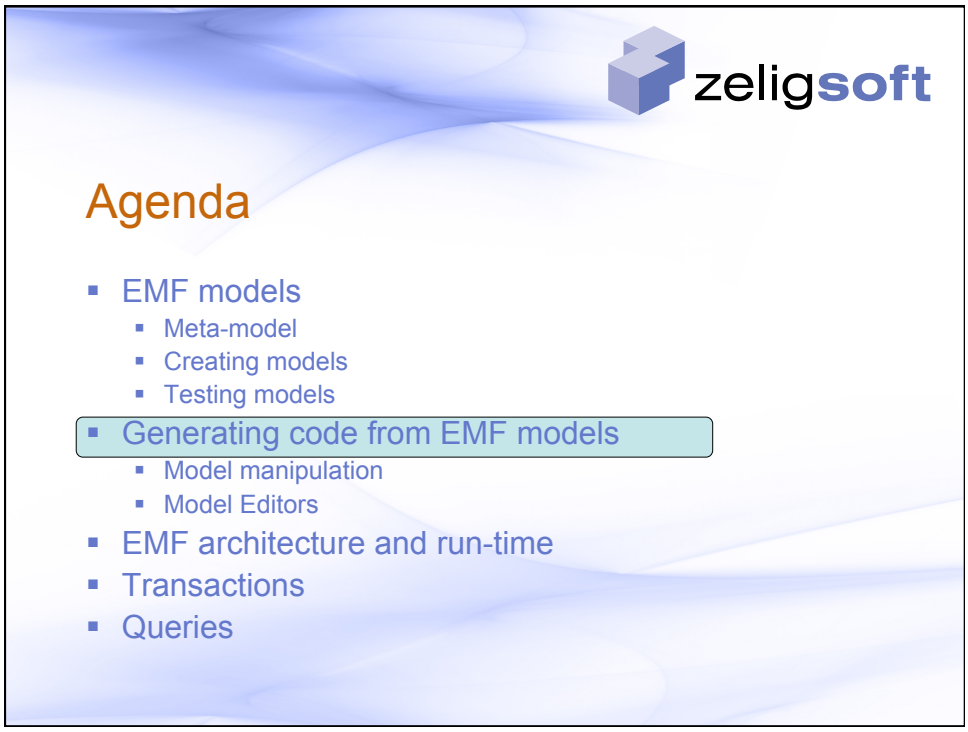
Summary
In this module we explored
What EMF is...
How to create Ecore models
Java
XML Schema
UML model
From scratch with Ecore Diagram Editor
How to test an Ecore model under development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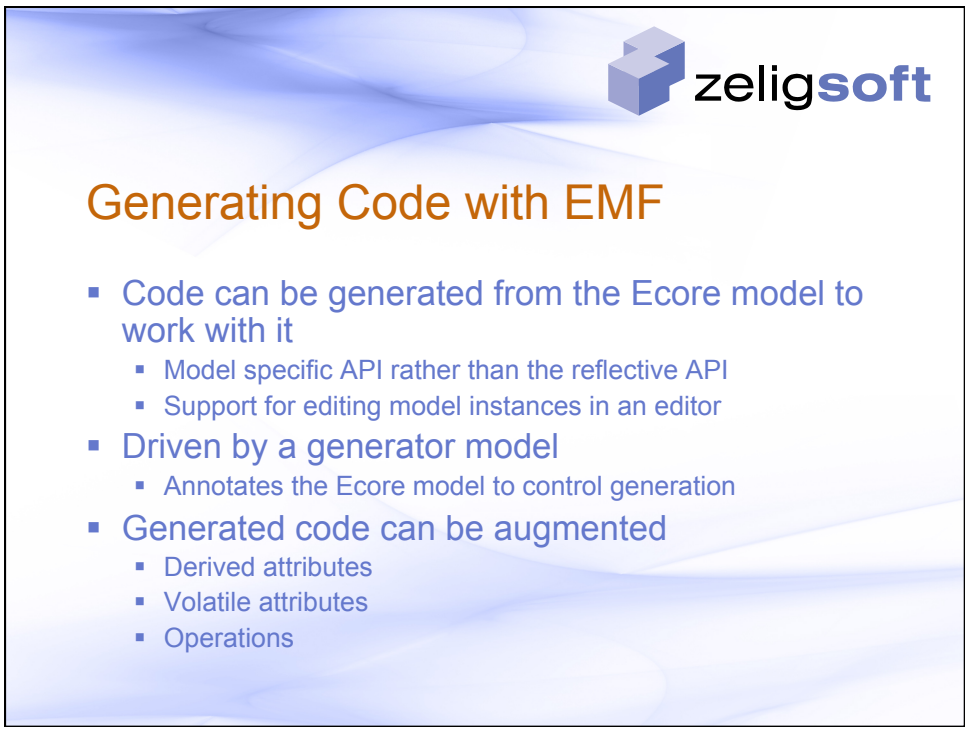
Agenda
EMF models
Meta-model
Creating models
Testing models
Generating code from EMF models
Model manipulation
Model Editors
EMF architecture and run-time
Transactions
Queries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Generating Code with EMF
Code can be generated from the Ecore model to work with it
Model specific API rather than the reflective API
Support for editing model instances in an editor
Driven by a generator model
Annotates the Ecore model to control generation
Generated code can be augmented
Derived attributes
Volatile attributes
Operations

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More Generating Code with EMF

- Full support for regeneration and merge
- Code can be customized
  - Configuration parameters
  - Custom templates
- Code can be generated from
  - Workbench
  - Ant script
  - Command line
  - *NOTE THAT BOTH ANT AND COMMAND LINE STILL REQUIRE ECLIPSE*

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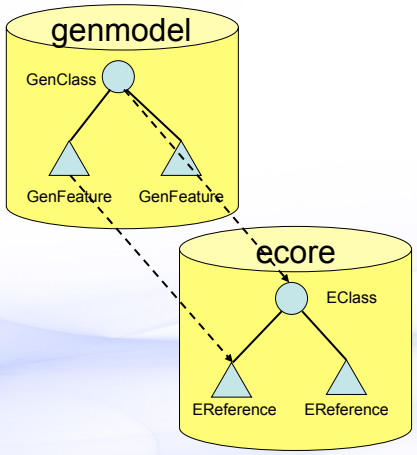
The genmodel

- Wraps the Ecore model and automatically kept in sync
  - Only true for Ecore
  - Others like Java require explicit reload
- Decorates the Ecore model
  - Target location for generated code
  - Prefix for some of the generated classes



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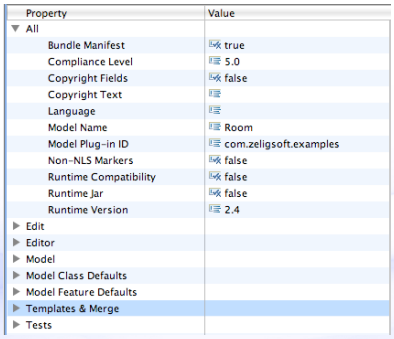
More genmodel

- Global generator configuration
- To generate
  - Context menu in the editor
  - Main menu in the editor
- Generates for
  - GenModel, GenPackage, GenClass and GenEnum
- What is generated
  - Model
  - Edit
  - Editor
  - Tests



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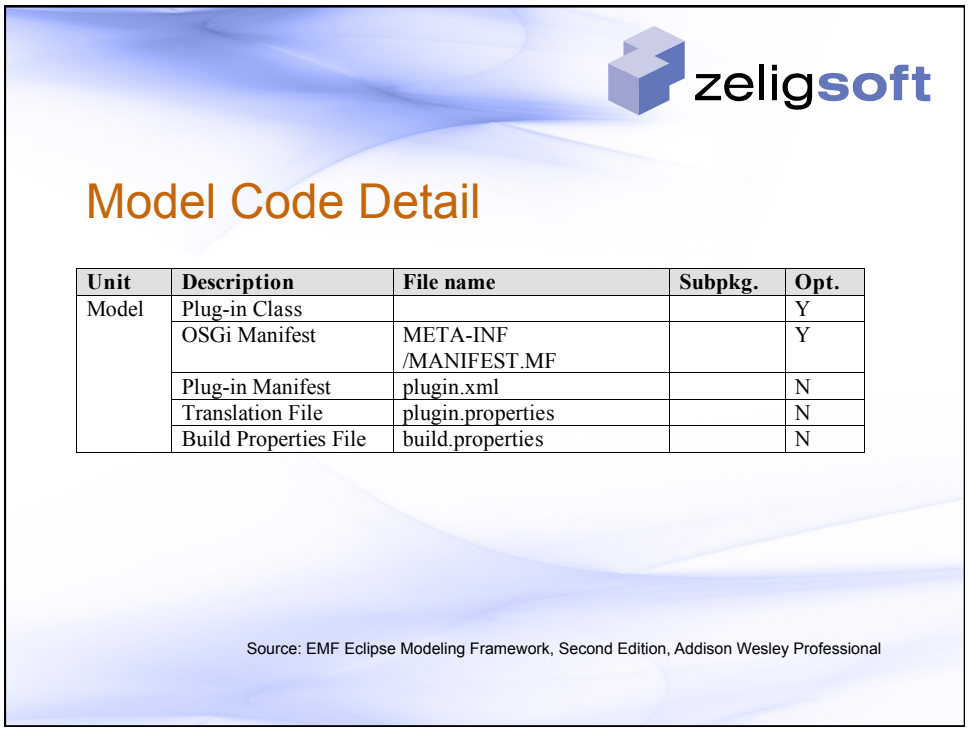
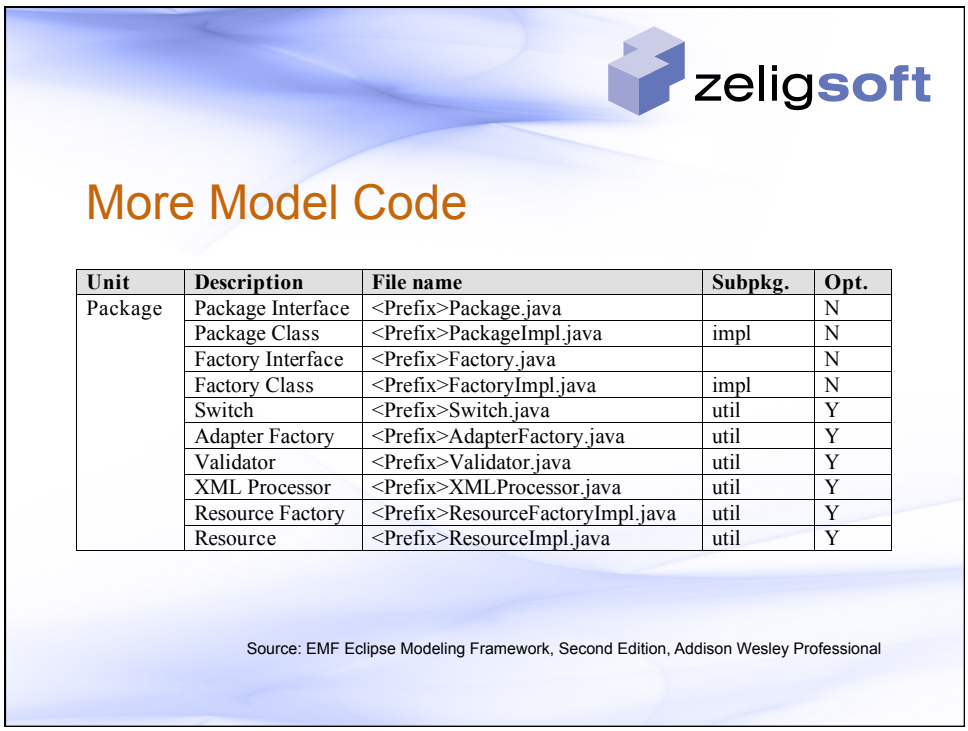
Model Code

- Java code for working with and manipulating model instances
- Interfaces, classes and enumerations
- Metadata
  - Package
- API for creating instances of classes
  - Factory
- Persistence
  - Resource and XML processor
- Utilities
  - E.g. Switch for visiting model elements



Unit	Description	File name	Subpkg.	Opt.
Model	Plug-in Class			Y
	OSGi Manifest	META-INF /MANIFEST.MF		Y
	Plug-in Manifest	plugin.xml		N
	Translation File	plugin.properties		N
	Build Properties File	build.properties		N



Unit	Description	File name	Subpkg.	Opt.
Package	Package Interface	<Prefix>Package.java		N
	Package Class	<Prefix>PackageImpl.java	impl	N
	Factory Interface	<Prefix>Factory.java		N
	Factory Class	<Prefix>FactoryImpl.java	impl	N
	Switch	<Prefix>Switch.java	util	Y
	Adapter Factory	<Prefix>AdapterFactory.java	util	Y
	Validator	<Prefix>Validator.java	util	Y
	XML Processor	<Prefix>XMLProcessor.java	util	Y
	Resource Factory	<Prefix>ResourceFactoryImpl.java	util	Y
	Resource	<Prefix>ResourceImpl.java	util	Y

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More Model Code

Unit	Description	File name	Subpkg.	Opt.
Class	Interface	<Name>.java		N
	Class	<Name>Impl.java	impl	N
Enum	Enum	<Name>.java		N

Source: EMF Eclipse Modeling Framework, Second Edition, Addison Wesley Professional

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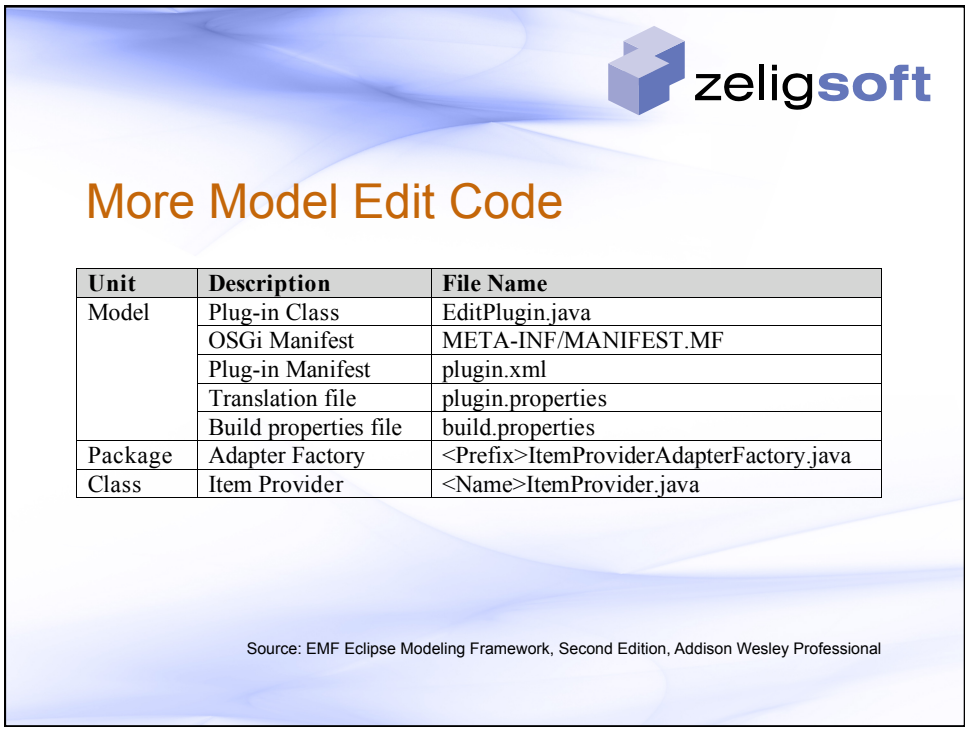
Model Edit Code

- User interface independent editor code
- Interfaces to support viewing and editing of model objects
  - Content and label provider functions
  - Property descriptors
  - Command factory
  - Forwarding change notifications
- Sample icons are generated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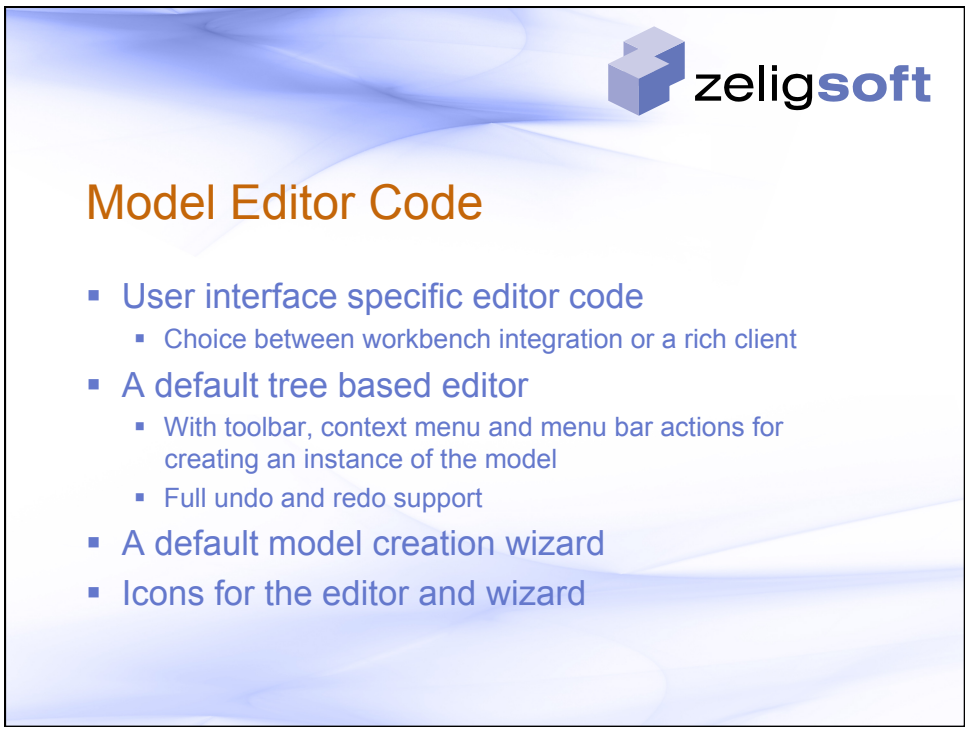
More Model Edit Code
Unit | Description | File Name
Model | Plug-in Class | EditPlugin.java
OSGi Manifest | META-INF/MANIFEST.MF
Plug-in Manifest | plugin.xml
Translation file | plugin.properties
Build properties file | build.properties
Package | Adapter Factory | <Prefix>ItemProviderAdapterFactory.java
Class | Item Provider | <Name>ItemProvider.java
Source: EMF Eclipse Modeling Framework, Second Edition, Addison Wesley Professional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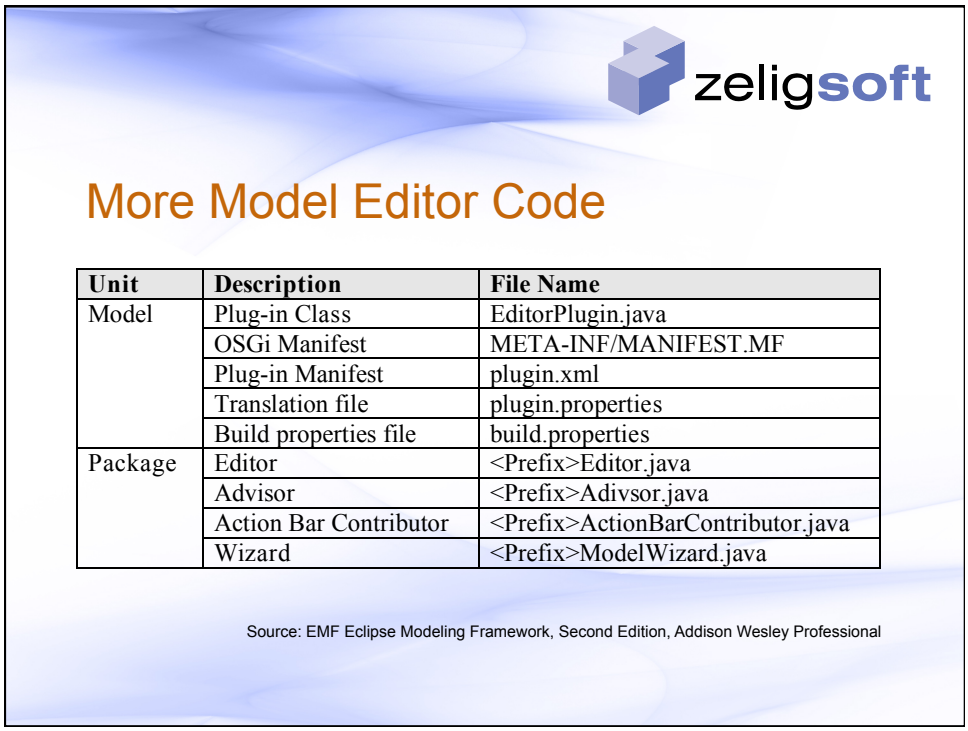
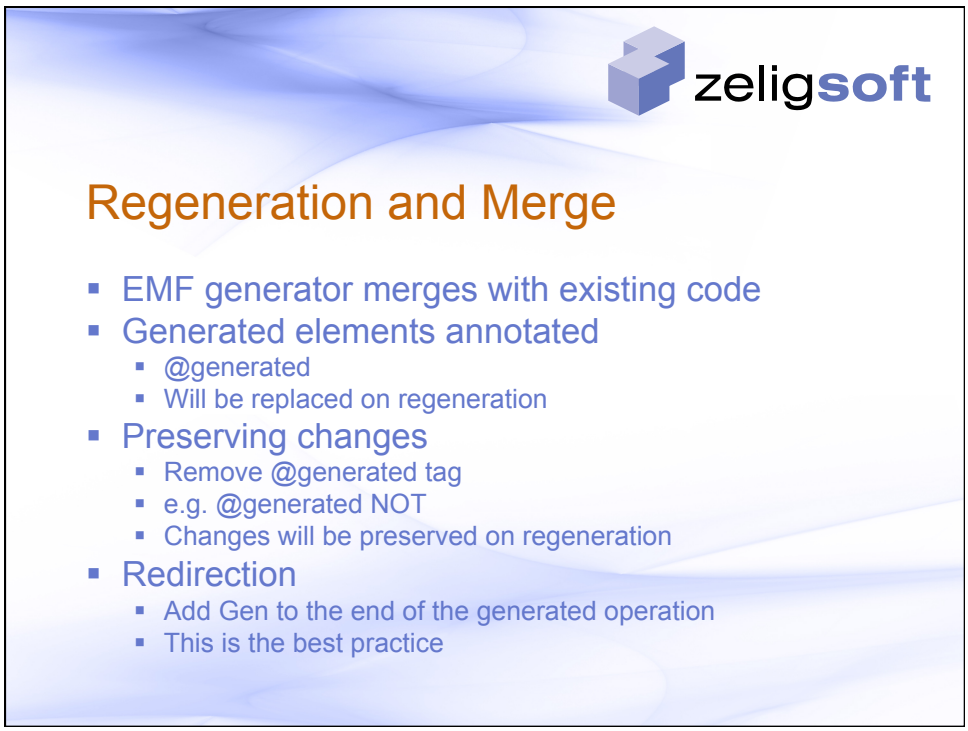
Model Editor Code
User interface specific editor code
Choice between workbench integration or a rich client
A default tree based editor
With toolbar, context menu and menu bar actions for creating an instance of the model
Full undo and redo support
A default model creation wizard
Icons for the editor and wizard


zeligsoft
More Model Editor Code
Unit | Description | File Name
Model | Plug-in Class | EditorPlugin.java
OSGi Manifest | META-INF/MANIFEST.MF
Plug-in Manifest | plugin.xml
Translation file | plugin.properties
Build properties file | build.properties
Package | Editor | <Prefix>Editor.java
Advisor | <Prefix>Adivsor.java
Action Bar Contributor | <Prefix>ActionBarContributor.java
Wizard | <Prefix>ModelWizard.java
Source: EMF Eclipse Modeling Framework, Second Edition, Addison Wesley Professional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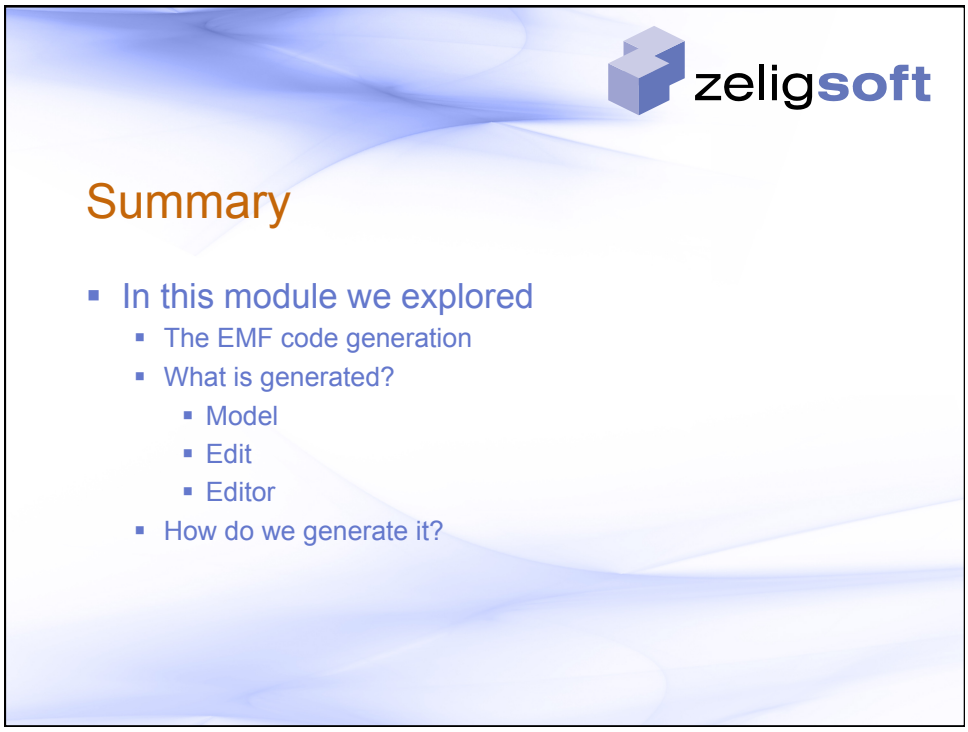
Regeneration and Merge
EMF generator merges with existing code
Generated elements annotated
@generated
Will be replaced on regeneration
Preserving changes
Remove @generated tag
e.g. @generated NOT
Changes will be preserved on regeneration
Redirection
Add Gen to the end of the generated operation
This is the best practice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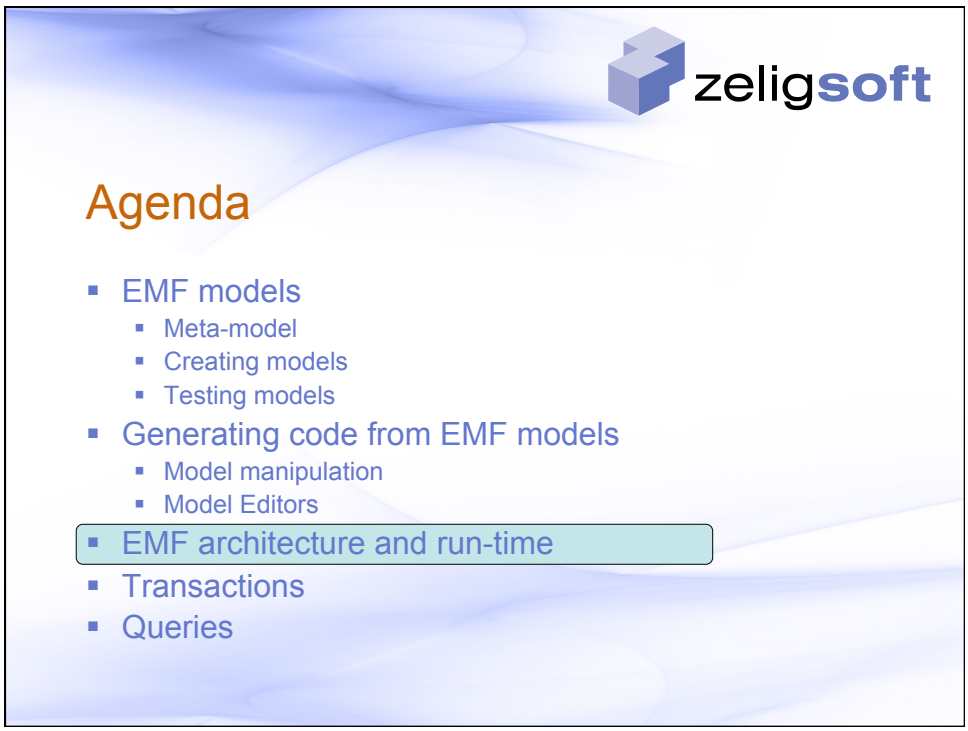
Summary
In this module we explored
The EMF code generation
What is generated?
Model
Edit
Editor
How do we generate it?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Agenda
EMF models
Meta-model
Creating models
Testing models
Generating code from EMF models
Model manipulation
Model Editors
EMF architecture and run-time
Transactions
Queries

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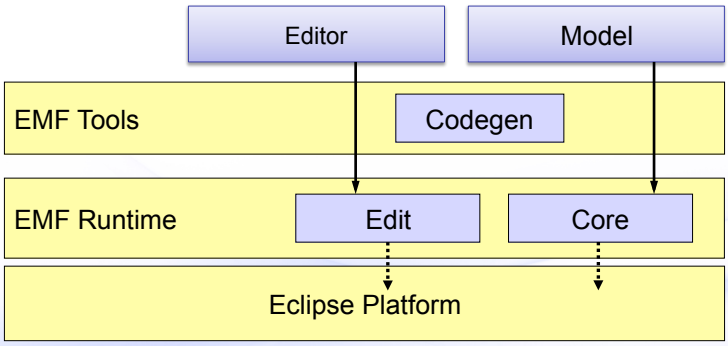
EMF Architecture



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EMF Runtime - Core

- Notification framework
- Ecore metamodel
- Persistence
- Validation
- Change model


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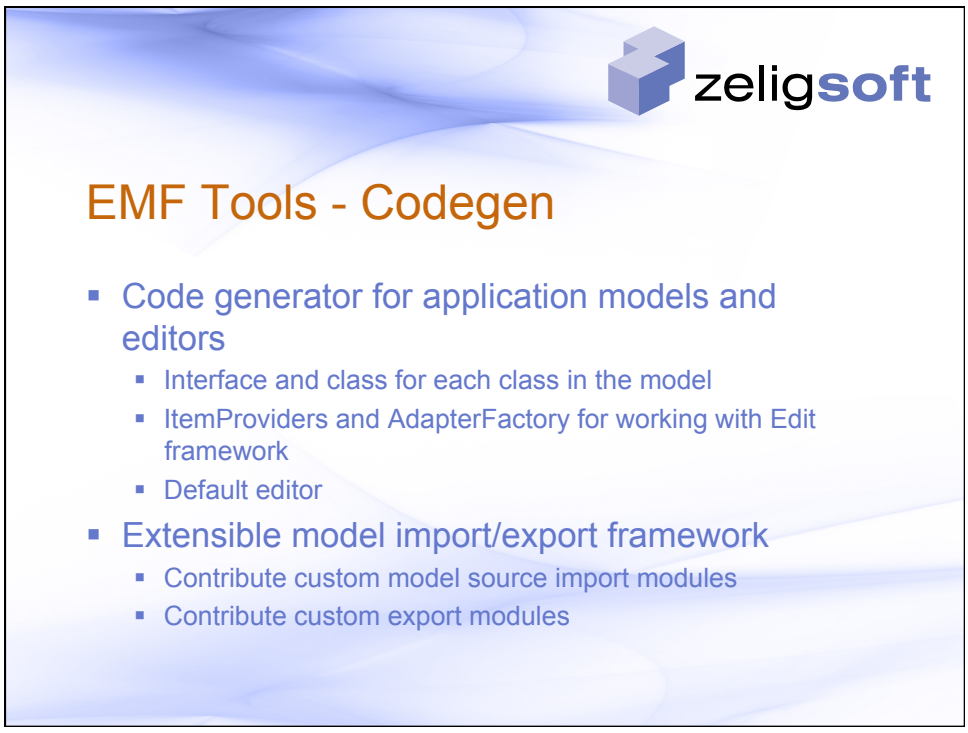
EMF Runtime - Edit
Support for model-based editors and viewers
Notification framework
Sends out notification whenever attribute or reference is changed
Observers (also an adapter) receive notification and can act
Default reflective editor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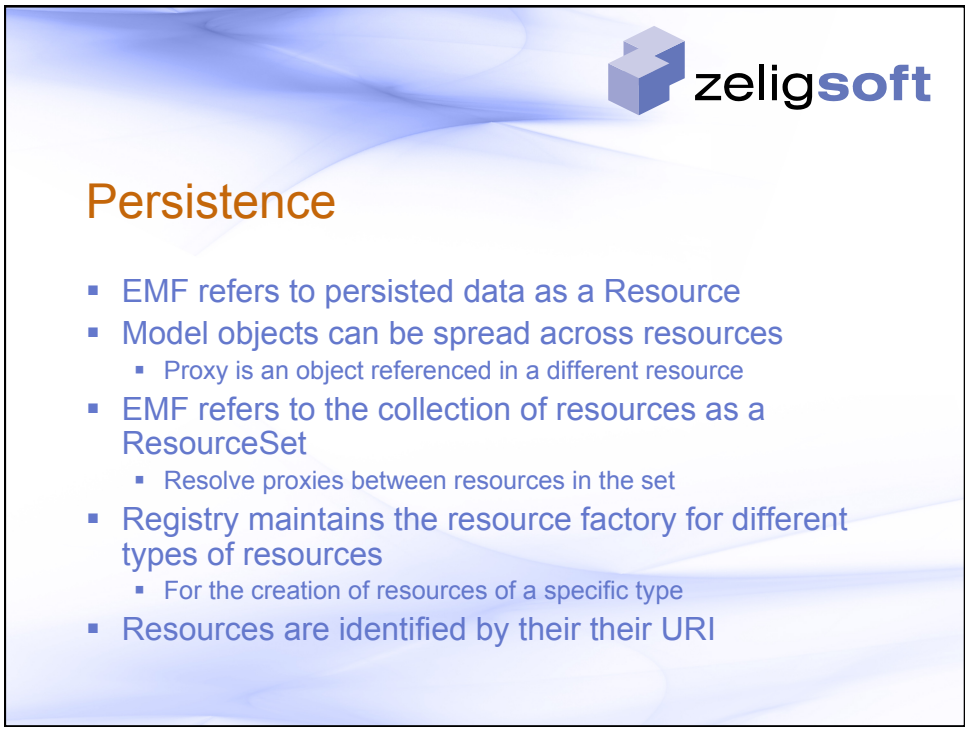
EMF Tools - Codegen
Code generator for application models and editors
Interface and class for each class in the model
ItemProviders and AdapterFactory for working with Edit framework
Default editor
Extensible model import/export framework
Contribute custom model source import modules
Contribute custom export modules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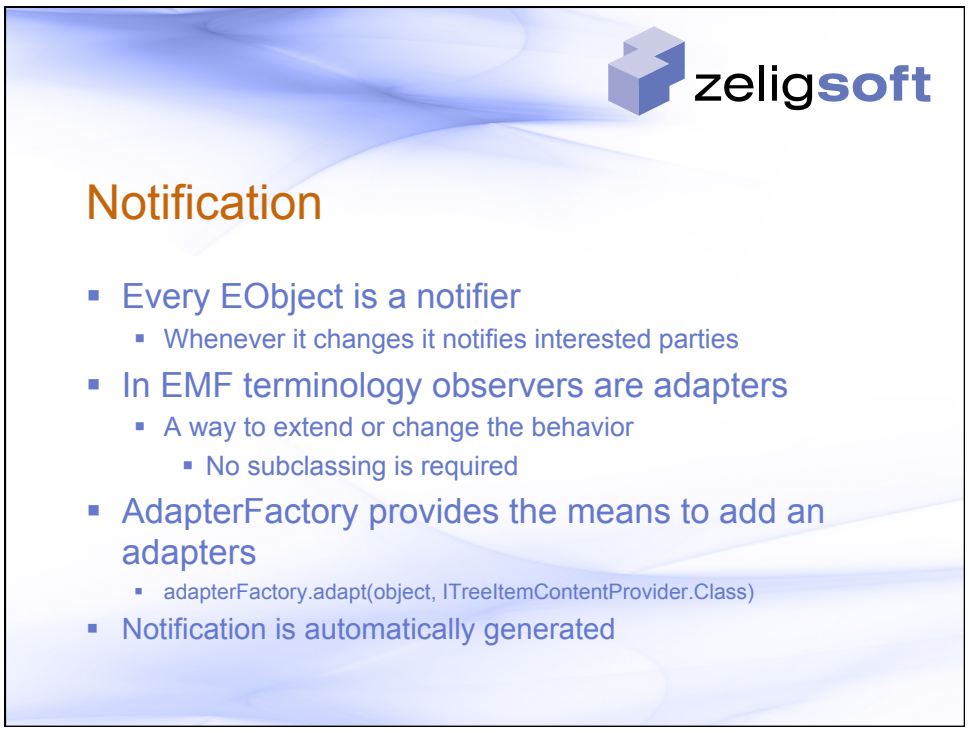
Persistence
EMF refers to persisted data as a Resource
Model objects can be spread across resources
Proxy is an object referenced in a different resource
EMF refers to the collection of resources as a ResourceSet
Resolve proxies between resources in the set
Registry maintains the resource factory for different types of resources
For the creation of resources of a specific type
Resources are identified by their their URI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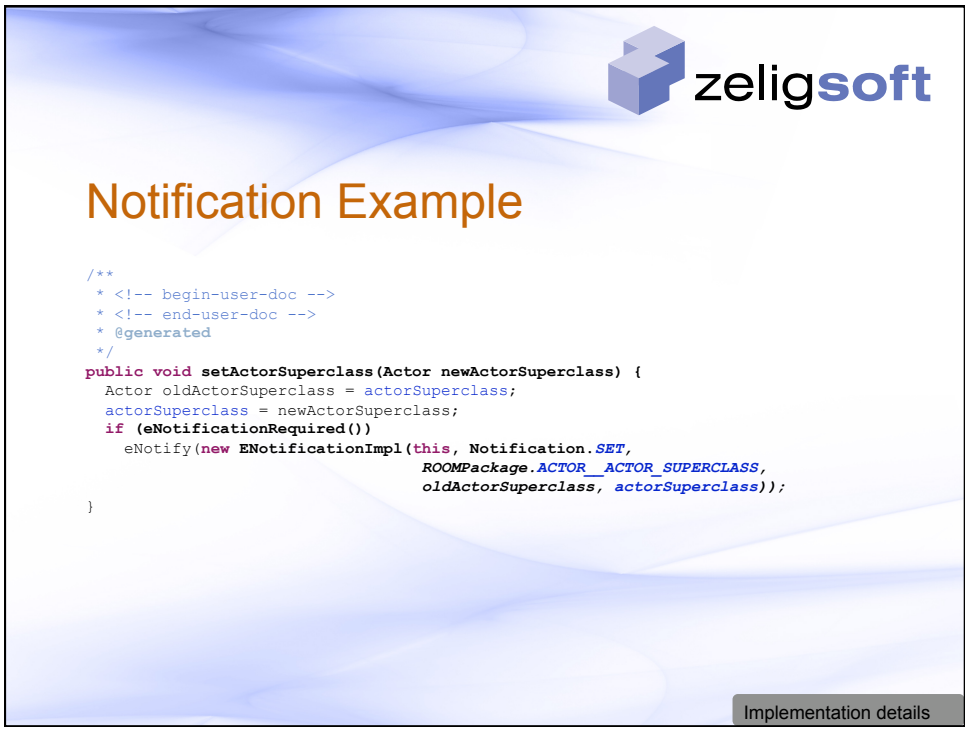
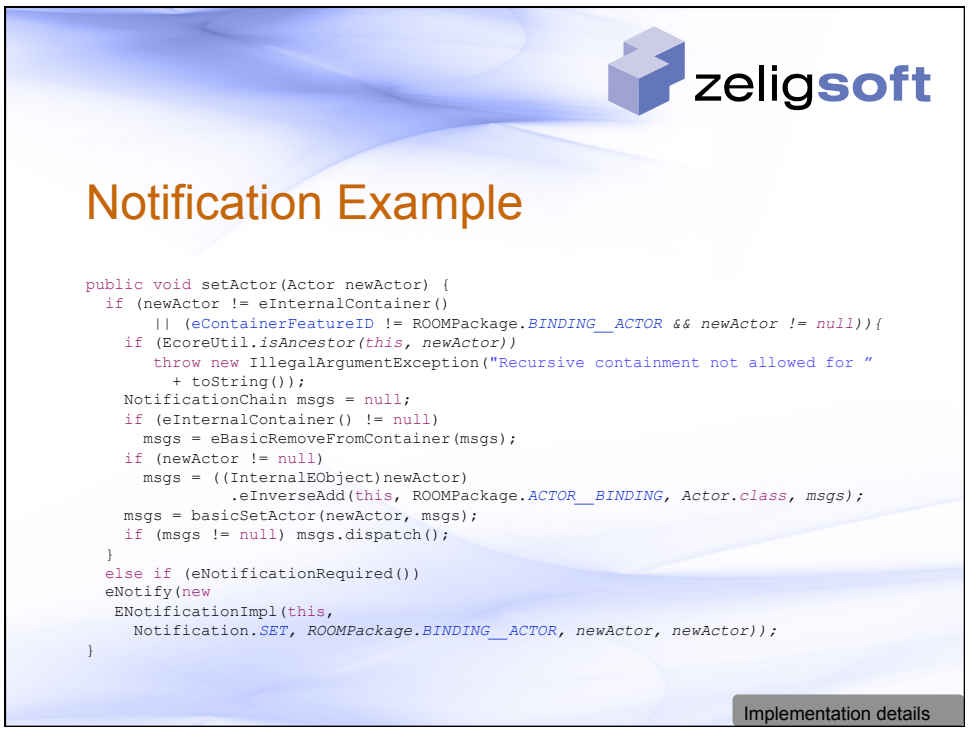
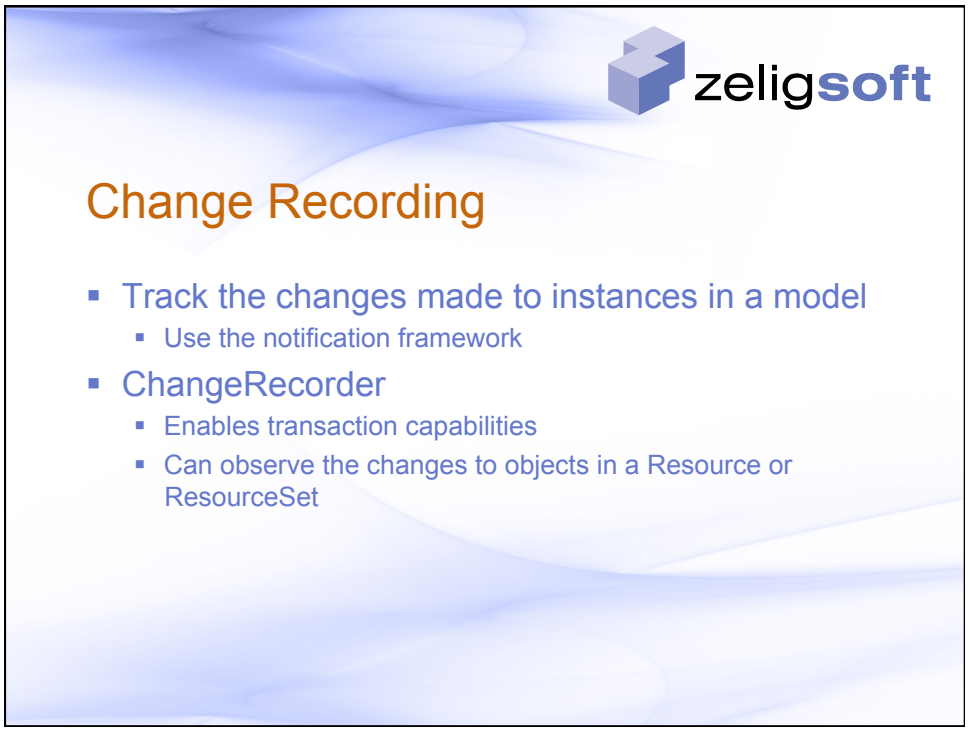
Notification
Every EObject is a notifier
Whenever it changes it notifies interested parties
In EMF terminology observers are adapters
A way to extend or change the behavior
No subclassing is required
AdapterFactory provides the means to add an adapters
adapterFactory.adapt(object, ITreeItemContentProvider.Class)
Notification is automatically generated





Toby McClean, Zeligsoft, 2008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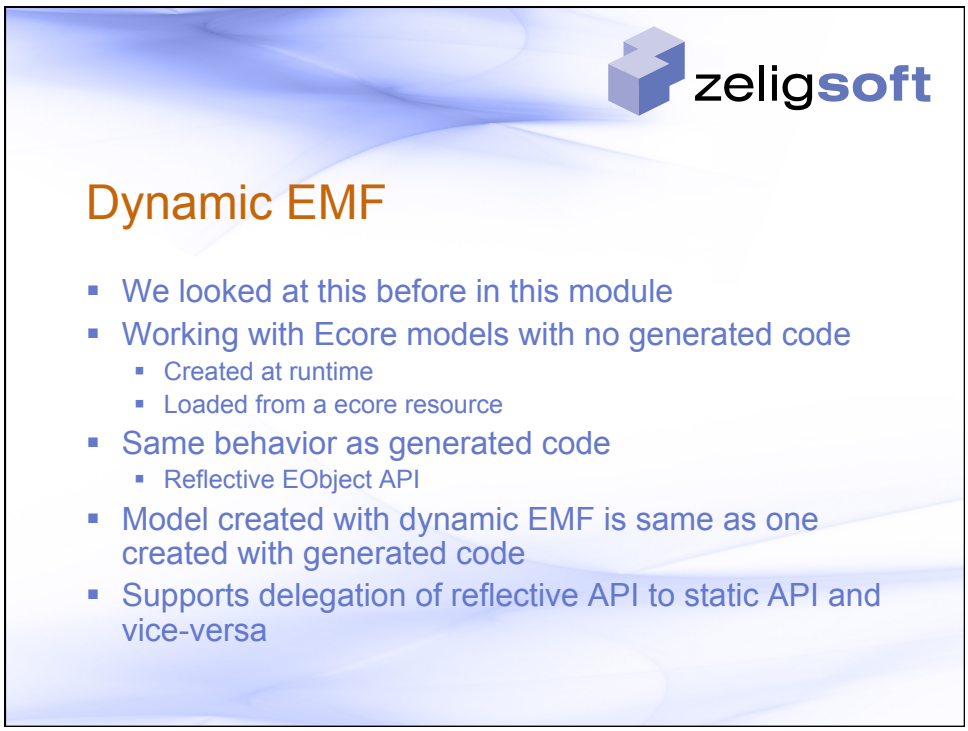
Change Recording
Track the changes made to instances in a model
Use the notification framework
ChangeRecorder
Enables transaction capabilities
Can observe the changes to objects in a Resource or ResourceSet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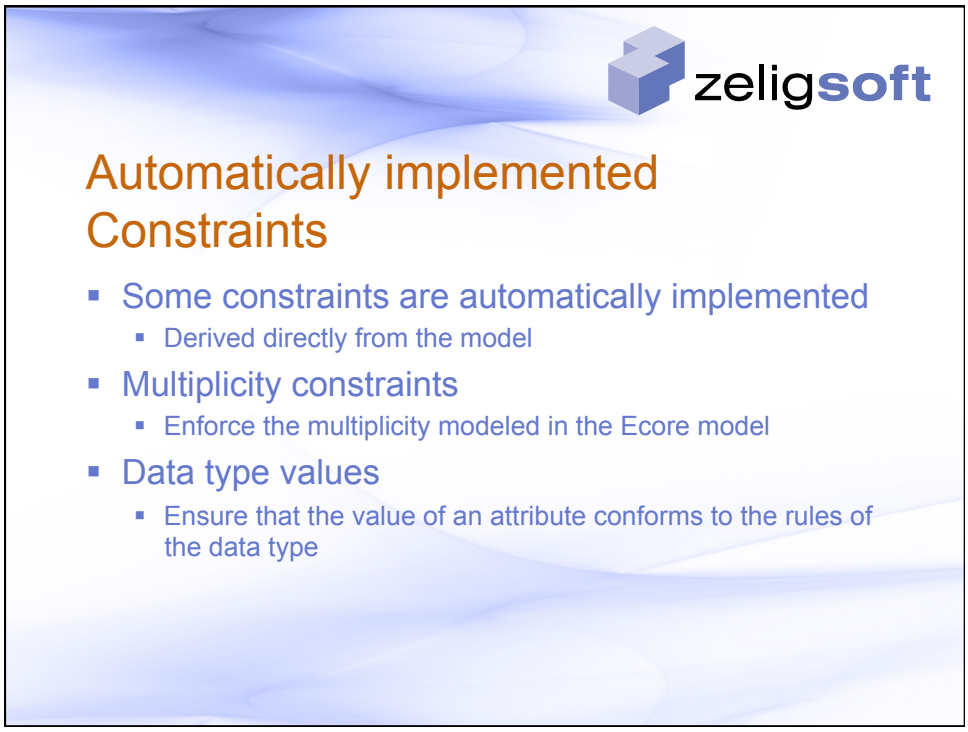
Dynamic EMF
We looked at this before in this module
Working with Ecore models with no generated code
Created at runtime
Loaded from a ecore resource
Same behavior as generated code
Reflective EObject API
Model created with dynamic EMF is same as one created with generated code
Supports delegation of reflective API to static API and vice-versa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Automatically implemented Constraints
Some constraints are automatically implemented
Derived directly from the model
Multiplicity constraints
Enforce the multiplicity modeled in the Ecore model
Data type values
Ensure that the value of an attribute conforms to the rules of the data type


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Validation
Infrastructure for providing rich invariants and constraints on the model
Will invoke the invariants and constraints
Requires the user to write the invariants and constraints
Invariants
Defined by operations on a class with signature
(EDiagnosticChain, EMap) : EBoolean
Constraints
Defined using a Validator
More on this in a later module


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EMF Utilities
Copying
EcoreUtil.copy
Equality
EcoreUtil.equal
Cross-referencing, contents/container navigation, annotation, proxy resolution, adapter selection, …


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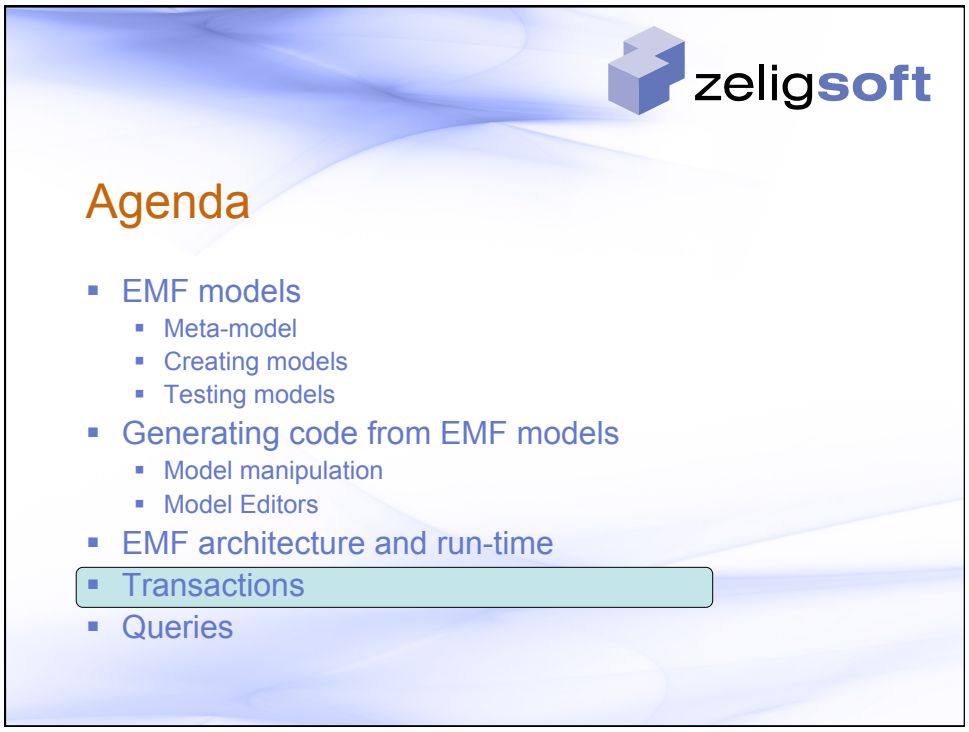
Summary
In this module we explored
EMF architecture
EMF runtime aspects
Notification
Persistance
Change recording
Validation and constraints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Agenda
EMF models
Meta-model
Creating models
Testing models
Generating code from EMF models
Model manipulation
Model Editors
EMF architecture and run-time
Transactions
Queries


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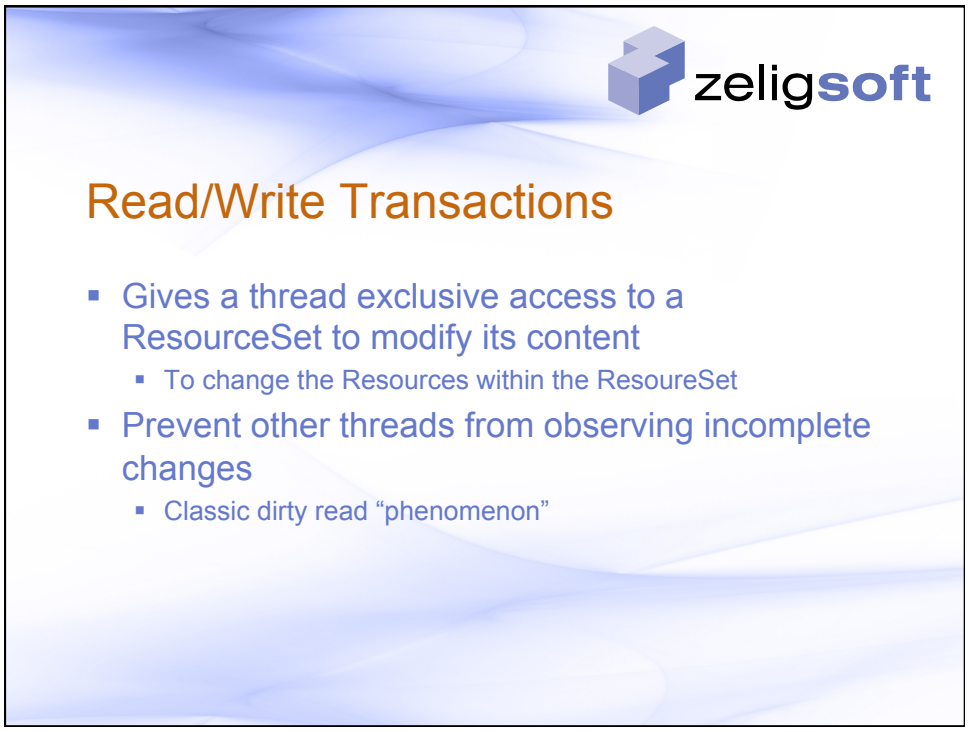
EMF Transaction
A framework for managing multiple readers and writers to EMF resources or sets of resources
An editing domain object manages access to resources
Can be shared amongst applications
A transaction object is the unit of work
Support for rolling back changes
Support for workbench undo/redo infrastructure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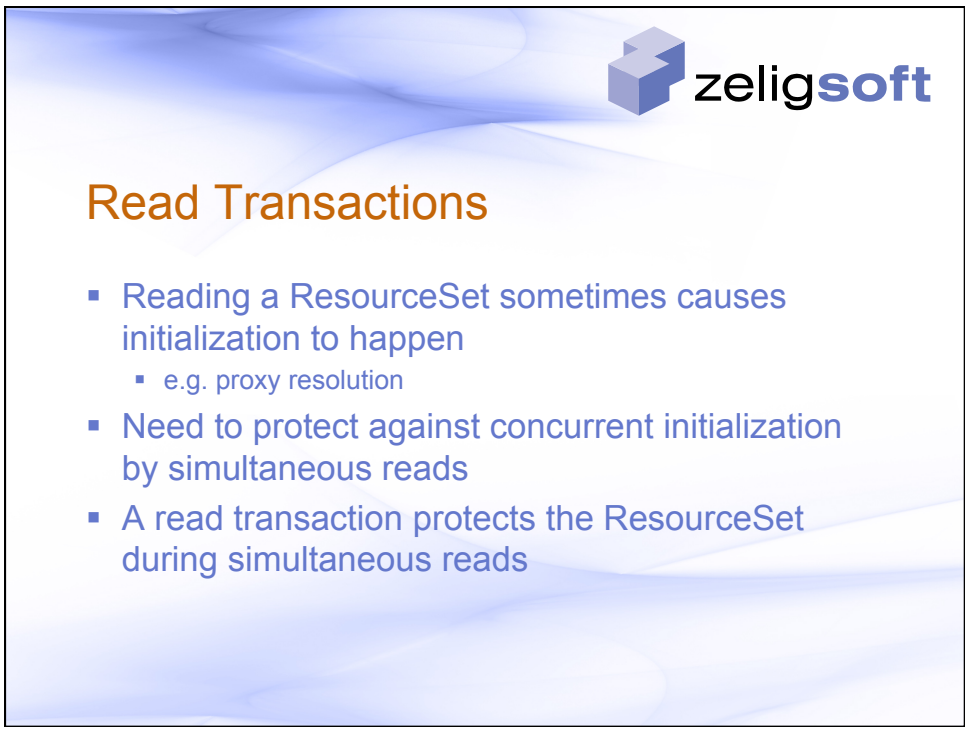
Read/Write Transactions
Gives a thread exclusive access to a ResourceSet to modify its content
To change the Resources within the ResoureSet
Prevent other threads from observing incomplete changes
Classic dirty read “phenomenon”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Read Transactions
Reading a ResourceSet sometimes causes initialization to happen
e.g. proxy resolution
Need to protect against concurrent initialization by simultaneous reads
A read transaction protects the ResourceSet during simultaneous reads


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Change Events
When a transaction is committed change notifications are sent to registered listeners
Includes a summary of changes
Successful commits send notifications as a batch
Prevents listeners from being overwhelmed
Has its quirks, too. Most notable is its asynchronous nature: the object that sent a notification may not be in either the old state nor the new state, so processing changes takes some getting used to


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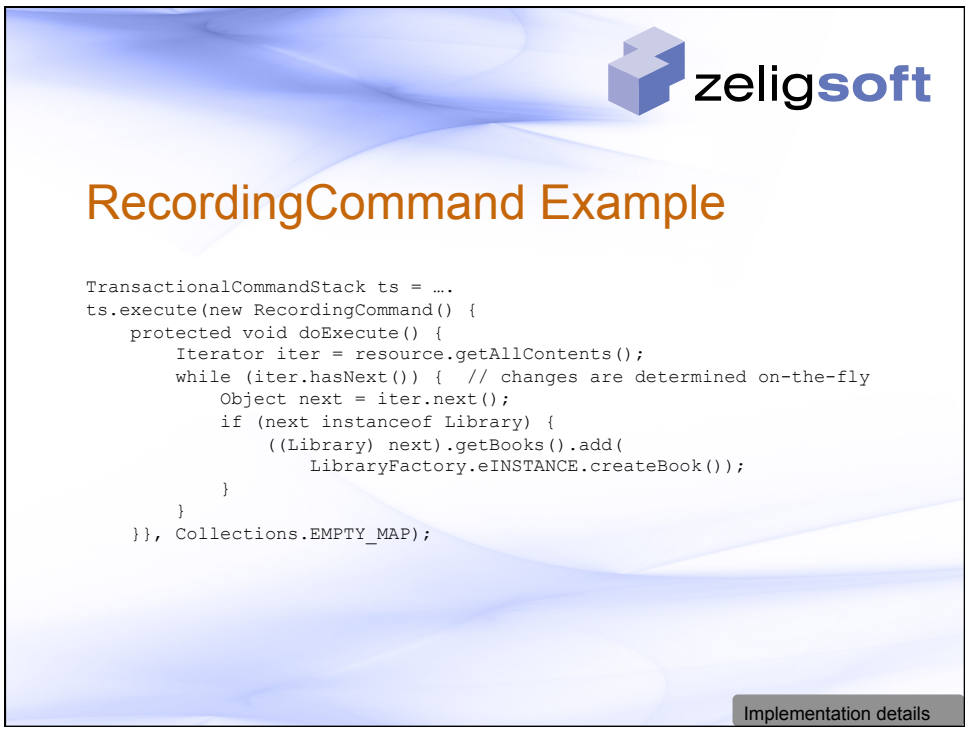
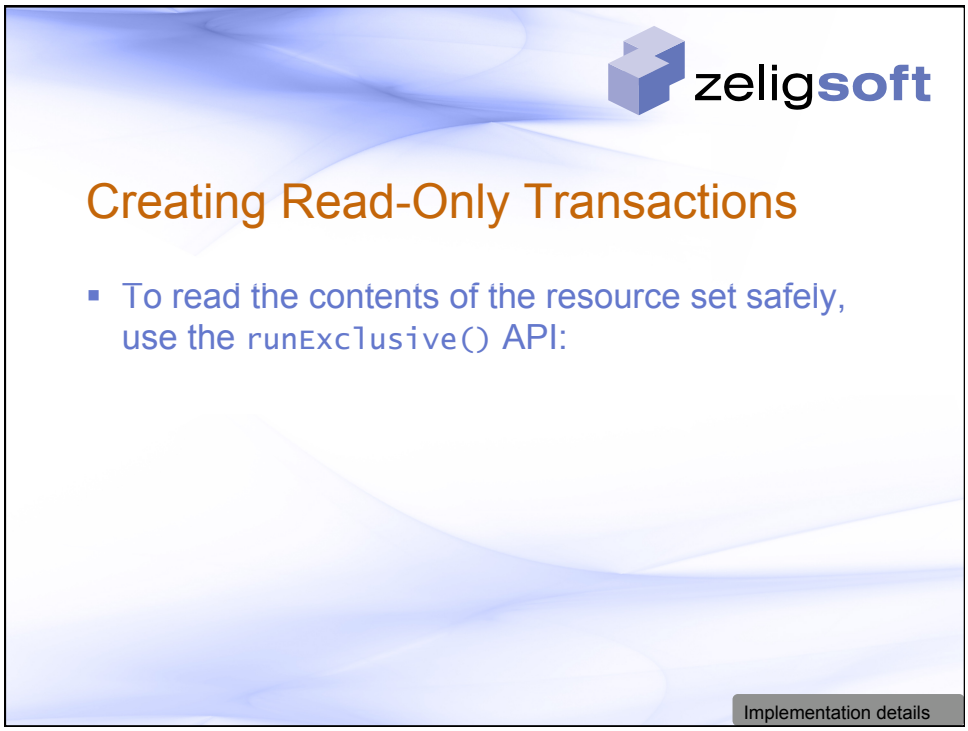
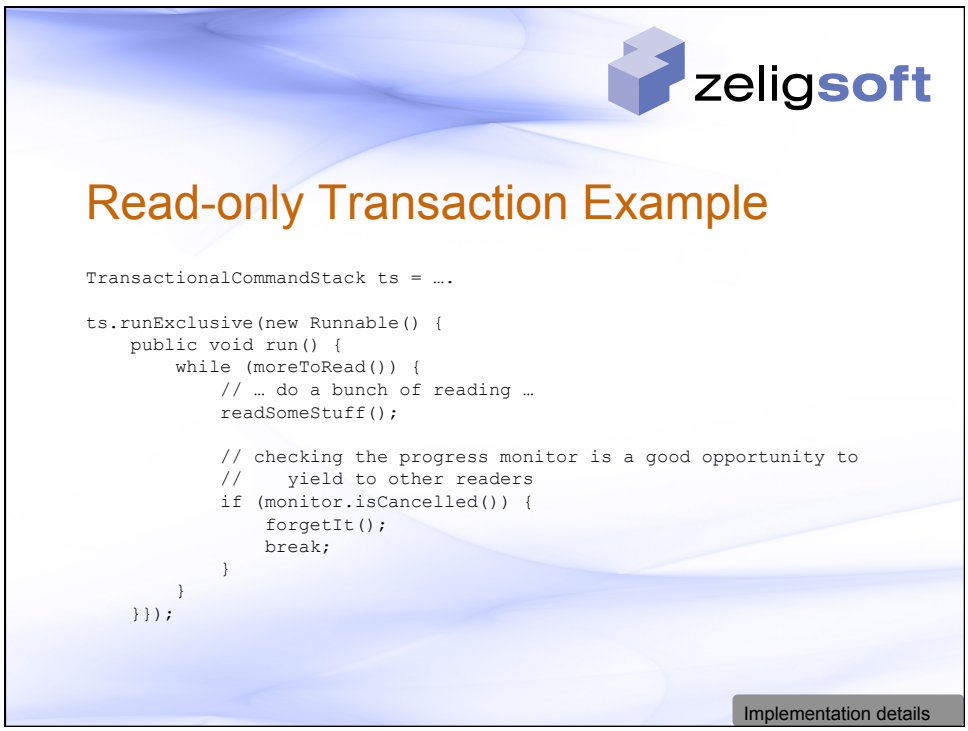
Creating Read/Write Transactions
To create a read/write transaction
Execute a command on the TransactionalCommandStack
TransactionalCommandStack::execute(Command, Map)
Transaction can be rolled back and it will be undone automatically
Supports undo and redo functionality
TransactionalCommandStack::undo
TransactionalCommandStack::redo

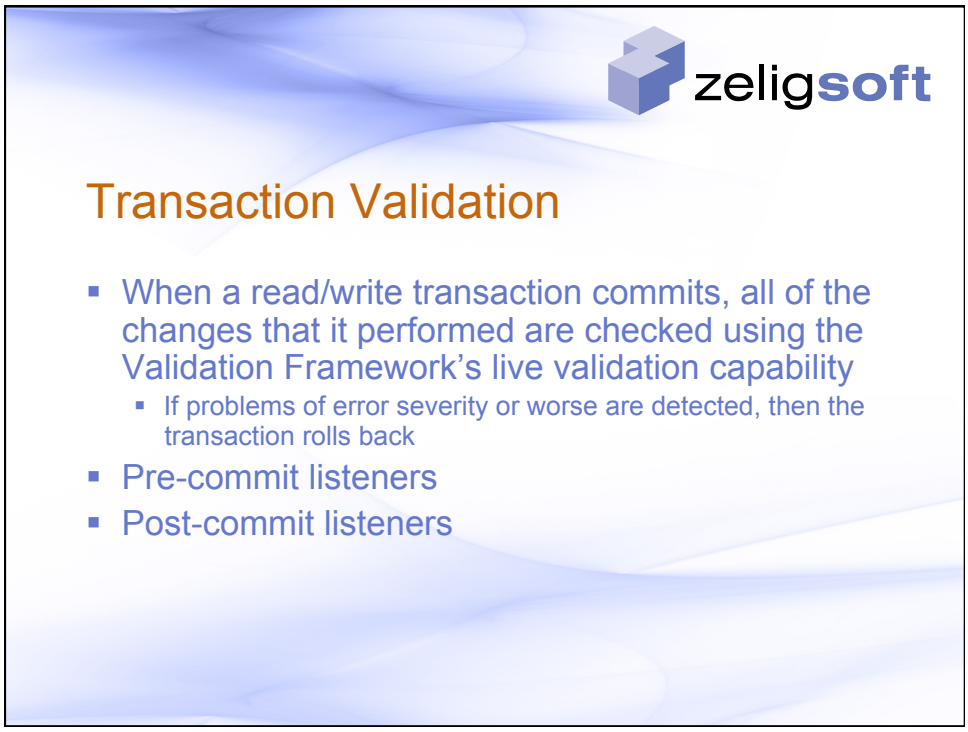


Toby McClean, Zeligsoft, 2008





Toby McClean, Zeligsoft, 2008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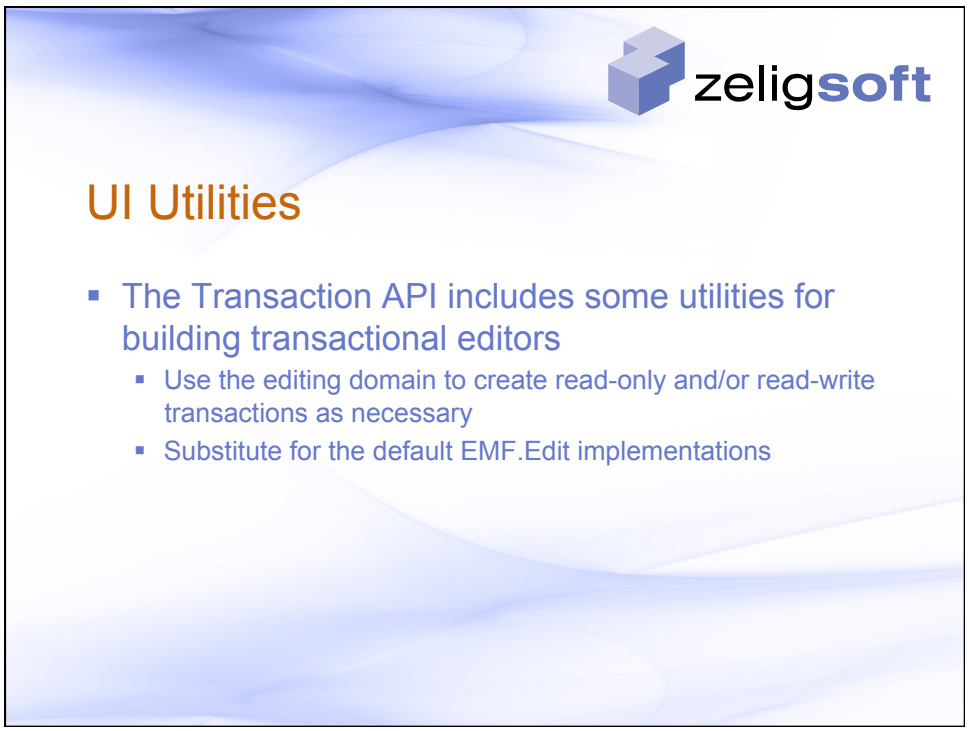
Transaction Validation
When a read/write transaction commits, all of the changes that it performed are checked using the Validation Framework's live validation capability
If problems of error severity or worse are detected, then the transaction rolls back
Pre-commit listeners
Post-commit listeners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UI Utilities
The Transaction API includes some utilities for building transactional editors
Use the editing domain to create read-only and/or read-write transactions as necessary
Substitute for the default EMF.Edit implementations


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ResourceSetListener
Avoid reacting to changes before they have been committed
If a transaction rolls back, no event is sent
Except for changes that are not undoable, such as proxy resolution and resource loading. In general, these are the changes that are compatible with a read-only transaction


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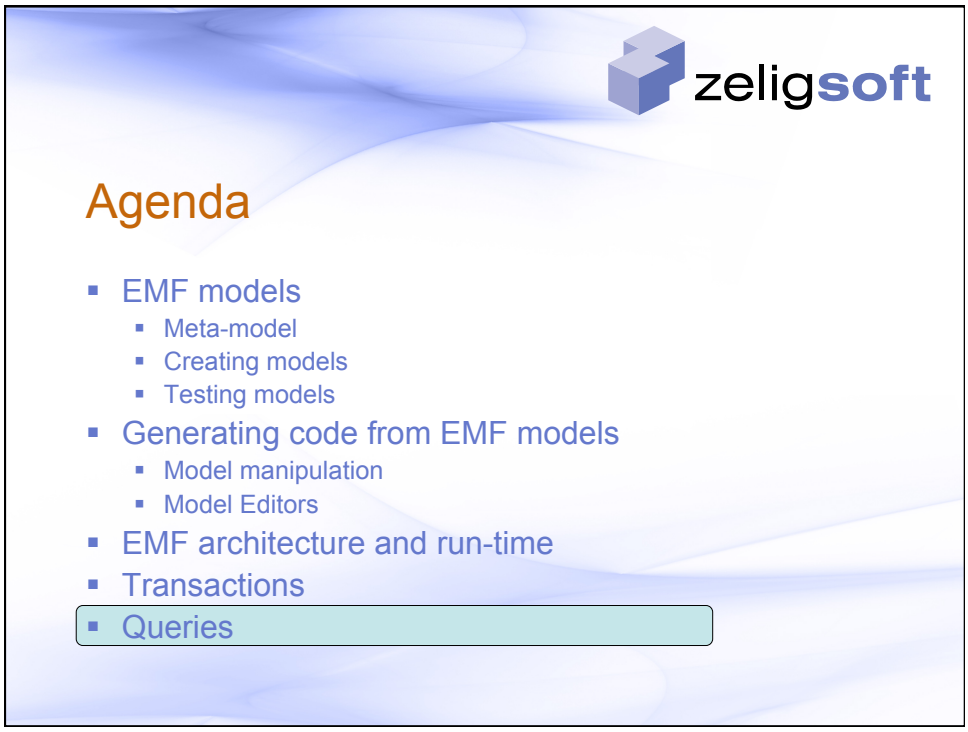
Summary
In this module we have discussed
EMF transactions and how to respond to their changes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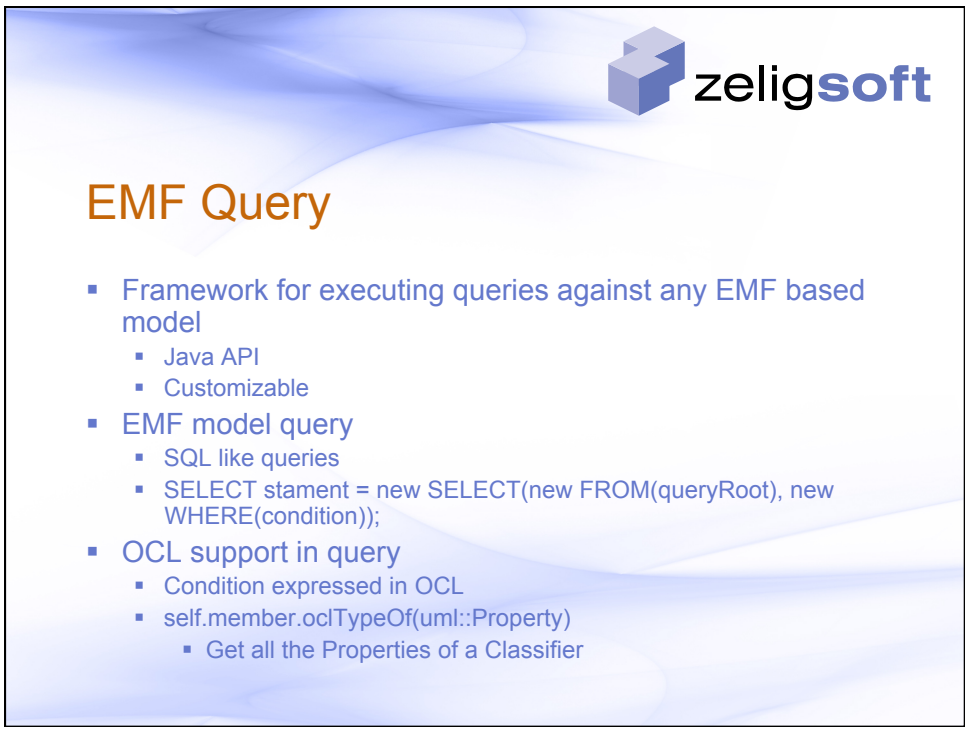
EMF architecture and run-time
Transactions
Queries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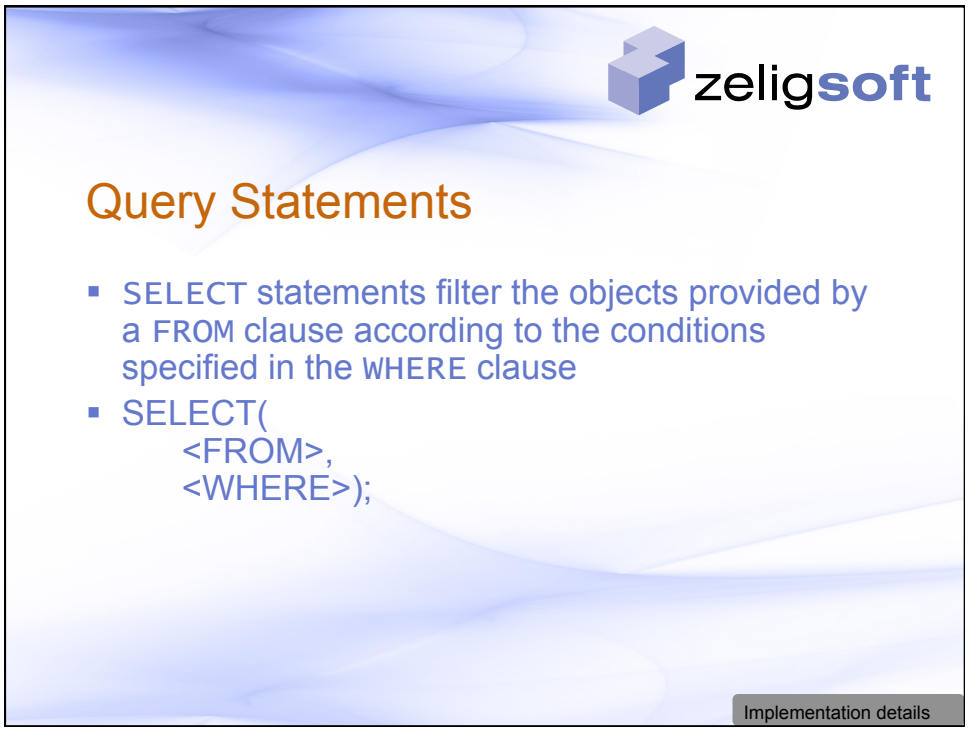
EMF Query
Framework for executing queries against any EMF based model
Java API
Customizable
EMF model query
SQL like queries
SELECT stament = new SELECT(new FROM(queryRoot), new WHERE(condition));
OCL support in query
Condition expressed in OCL
self.member.oclTypeOf(uml::Property)
Get all the Properties of a Classifier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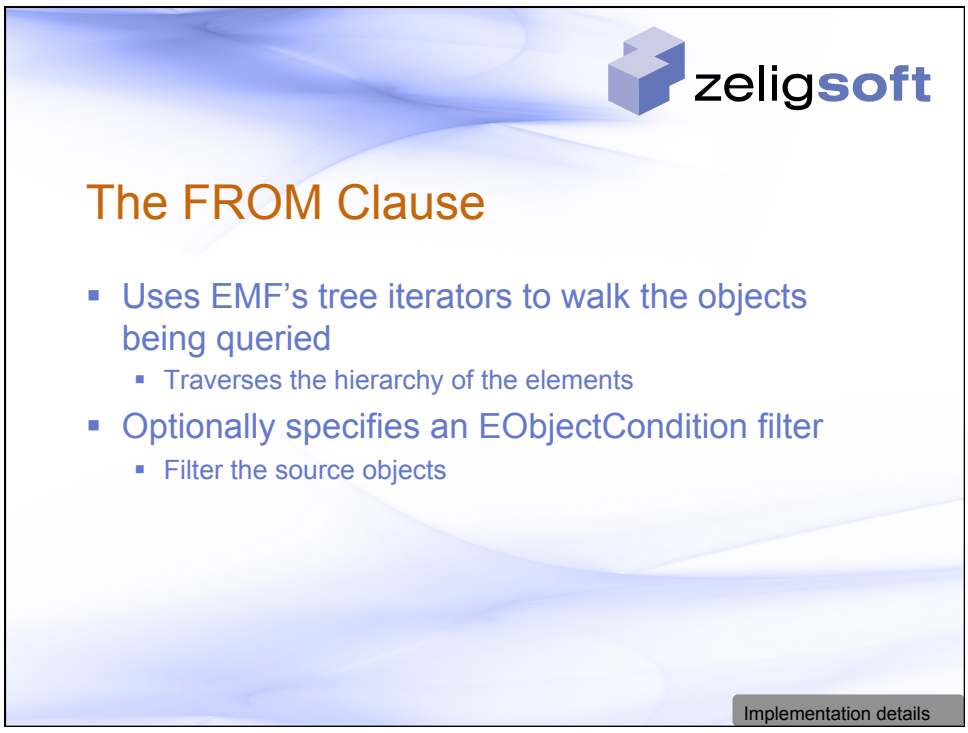
Query Statements
SELECT statements filter the objects provided by a FROM clause according to the conditions specified in the WHERE clause
SELECT(
<FROM>,
<WHERE>);
Implementation details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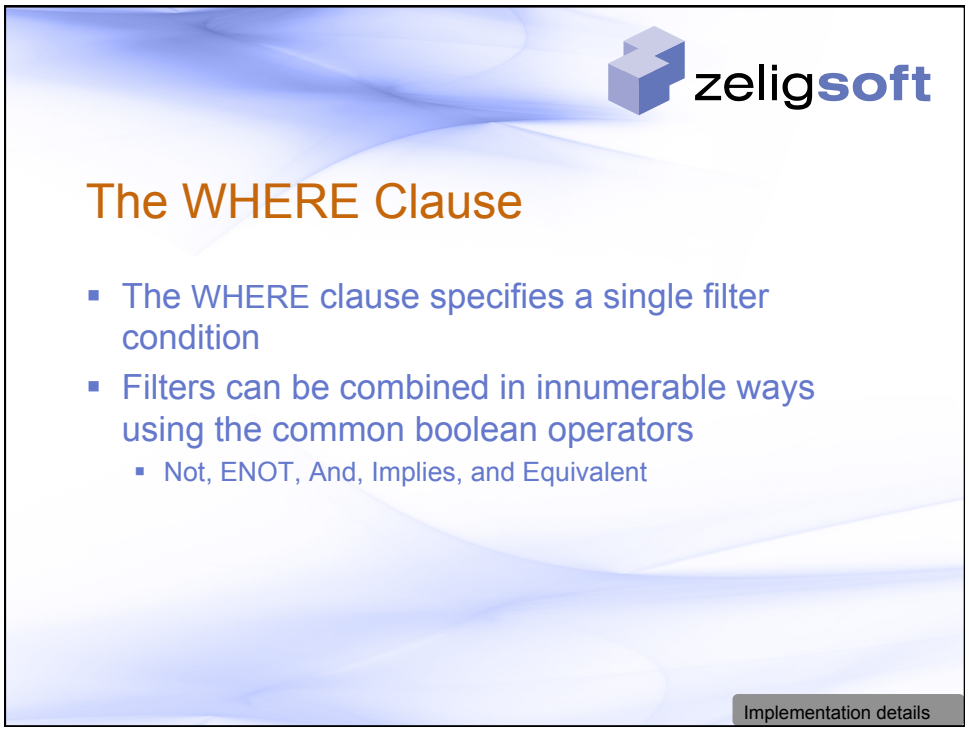
The FROM Clause
Uses EMF's tree iterators to walk the objects being queried
Traverses the hierarchy of the elements
Optionally specifies an EObjectCondition filter
Filter the source objects
Implementation details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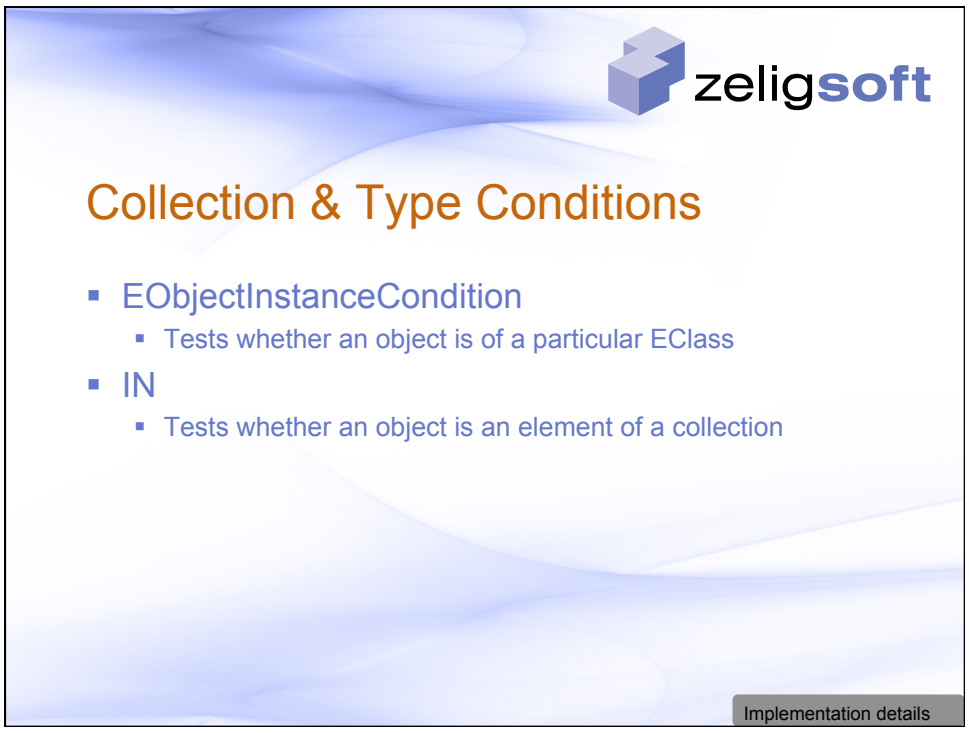
The WHERE Clause
The WHERE clause specifies a single filter condition
Filters can be combined in innumerable ways using the common boolean operators
Not, ENOT, And, Implies, and Equivalent
Implementation details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Collection & Type Conditions
EObjectInstanceCondition
Tests whether an object is of a particular EClass
IN
Tests whether an object is an element of a collection
Implementation details

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EAttributes Conditions

- The framework includes a variety of conditions for working with primitive-valued `EAttributes`
  - StringLength, StringRegularExpressionValue, StringValue, SubStringValue
  - NumberCondition.* with NumberCondition.RelationalOperator
  - BooleanCondition
- EAttributeValueCondition
- Adapters convert inputs to the required data type

Implementation details

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EReference Conditions

- EObjectContainmentCondition
  - Tests for the containing feature to see if it is the same as a specific EReference
- EObjectReferencerCondition
  - Tests if an EObject references another EObject
- EObjectReferenceValueCondition
  - Test the value of an EReference

Implementation details

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OCL Conditions

- OCL can be used to specify `WHERE` clause conditions
  - OCLConstraintCondition
- Specifies a boolean-valued expression (i.e., a constraint) that selects those elements for which the expression is satisfied
- Requires that the MDT OCL component

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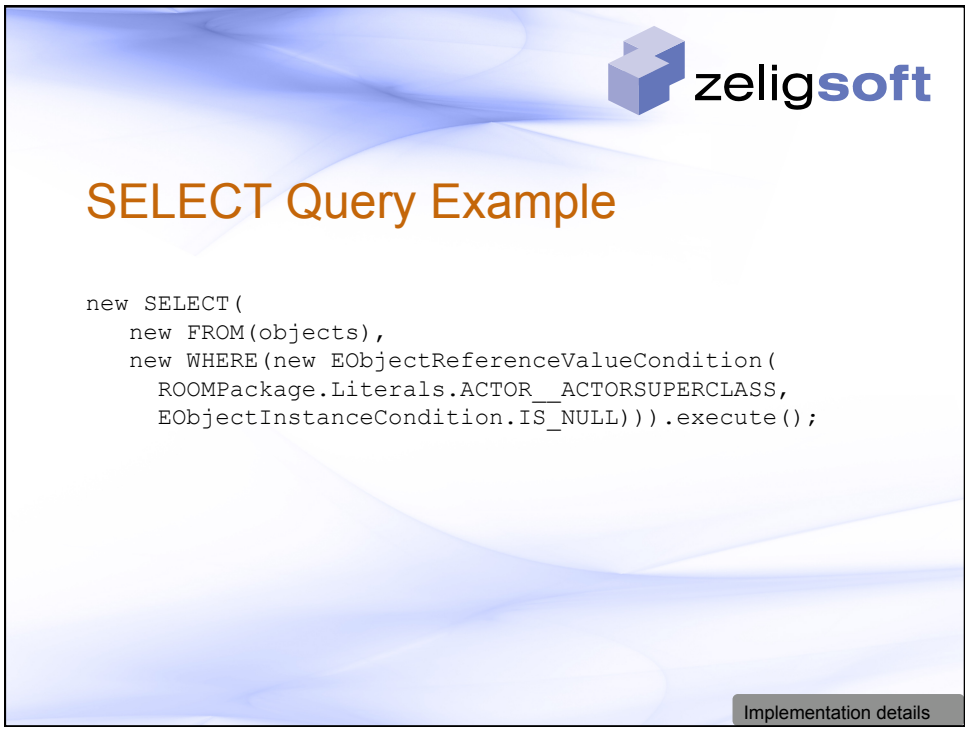
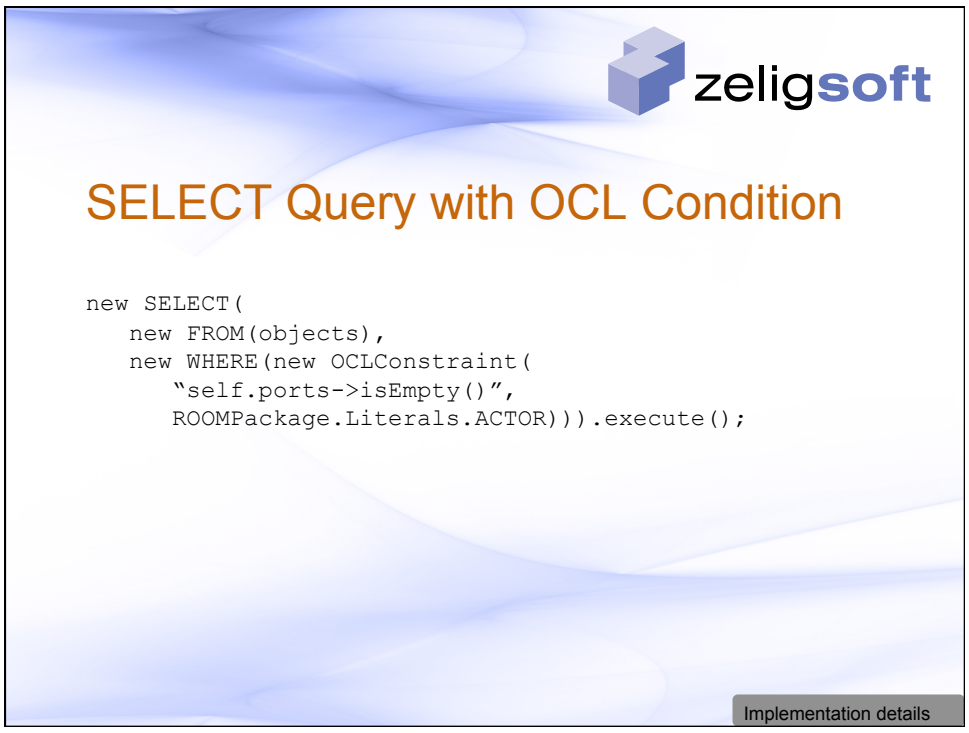
The UPDATE Statement

- Passes the SELECT objects to the SET clause
- The result is the subset of the SELECT objects that were modified by the SET clause





Toby McClean, Zeligsoft, 2008

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Summary

- In this module we explored
  - How to query EMF models

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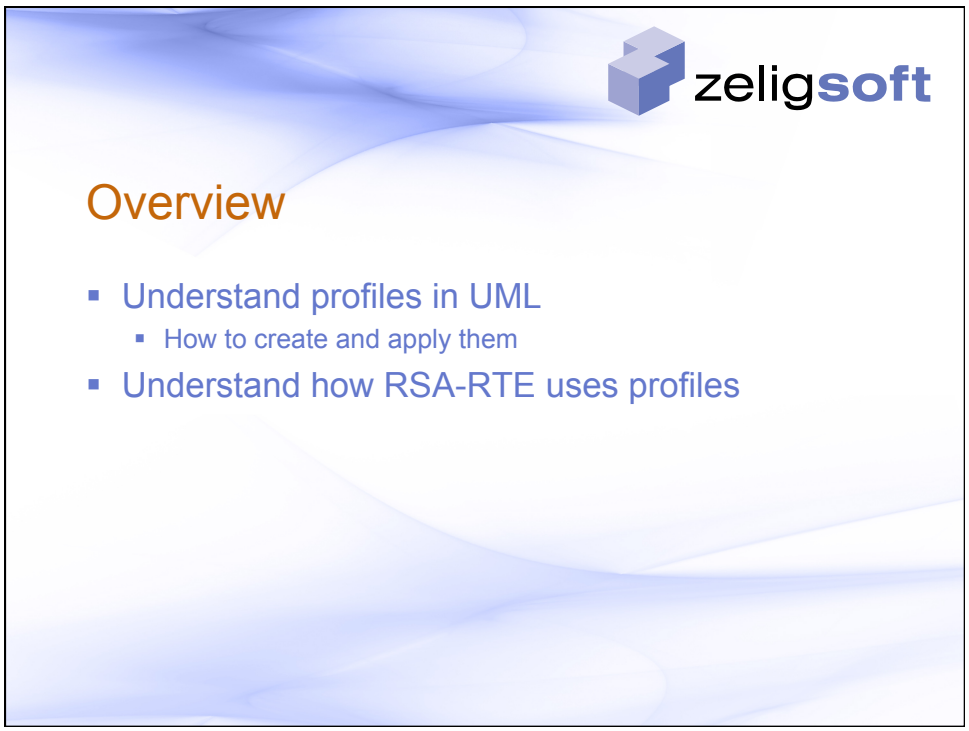
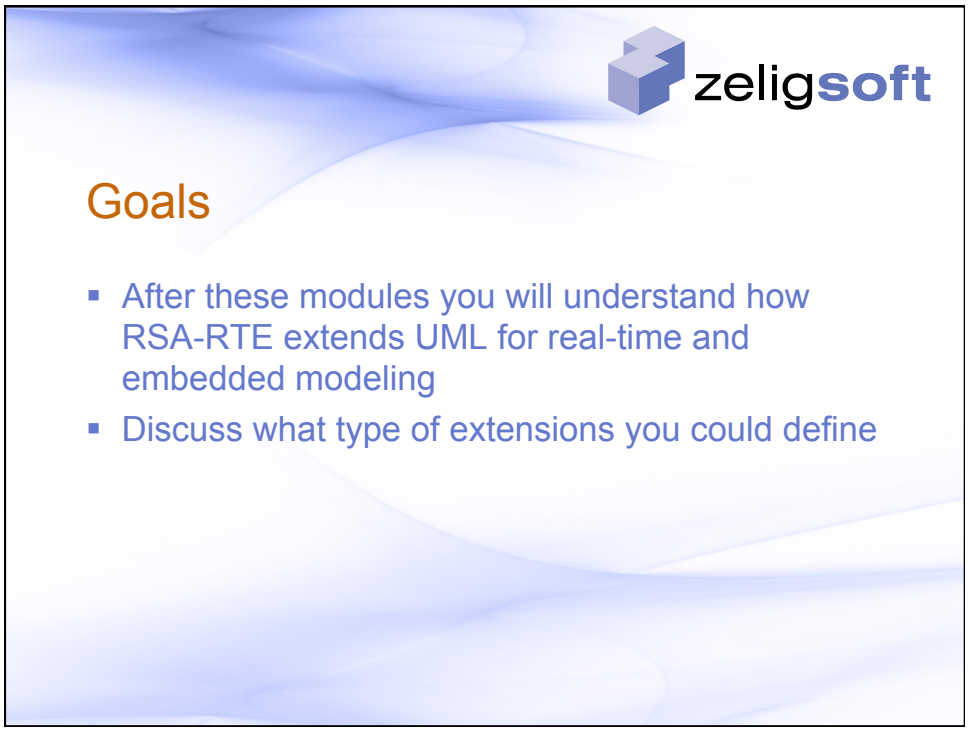
Questions



Toby McClean, Zeligsoft, 2008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Goals
After these modules you will understand how RSA-RTE extends UML for real-time and embedded modeling
Discuss what type of extensions you could define


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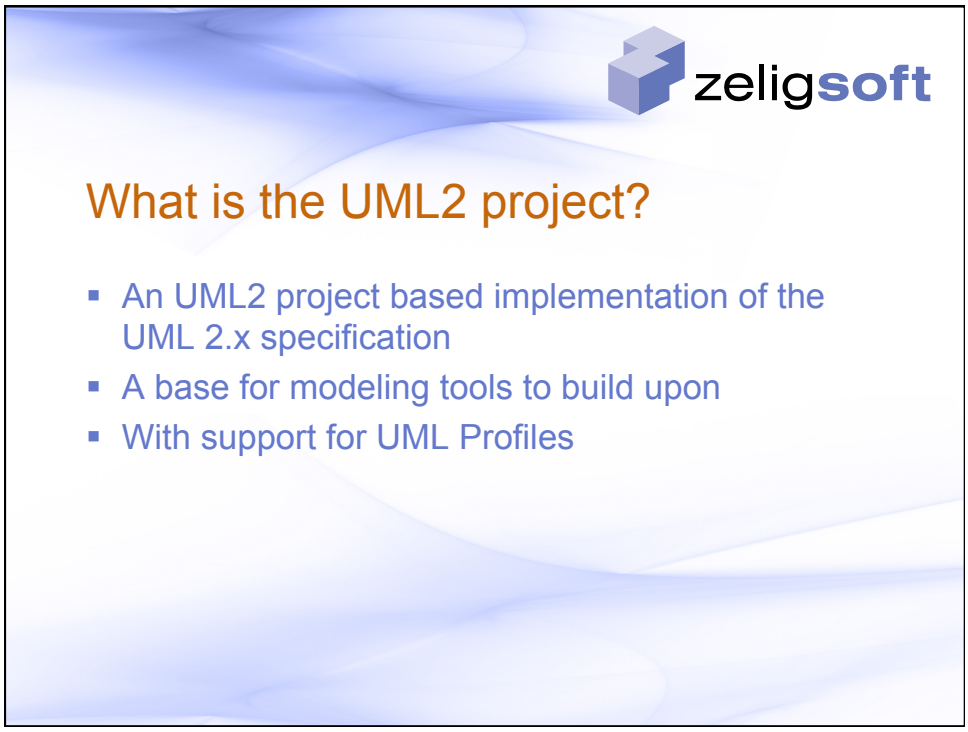
Agenda
UML2 models
Extending UML2 models
Keywords, profiles, stereotypes
RSA-RTE and profiles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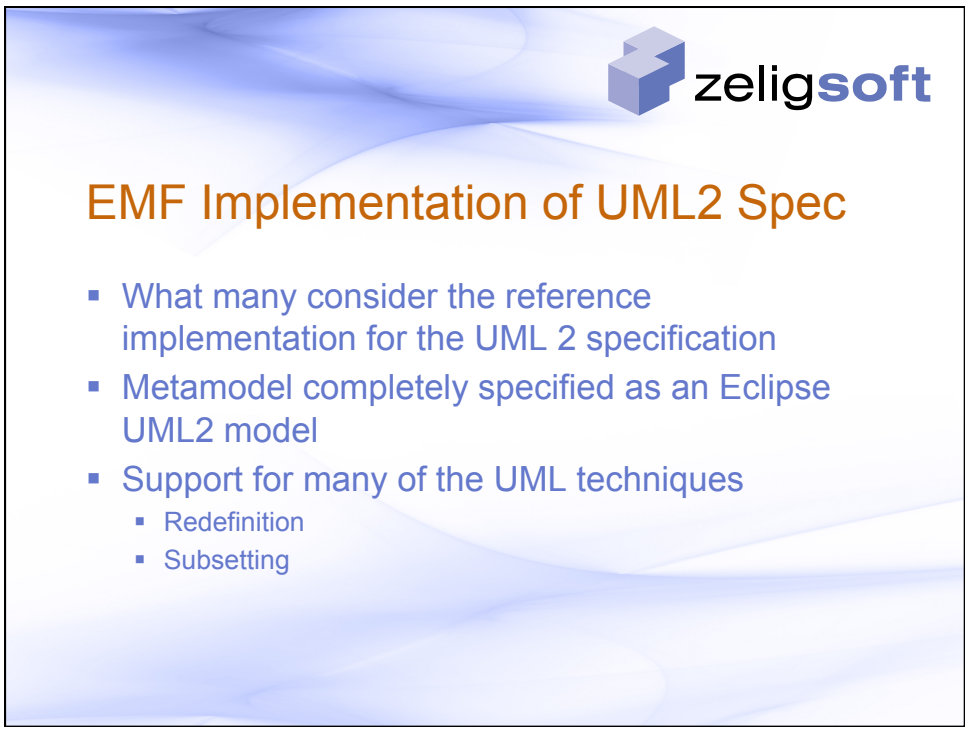
What is the UML2 project?
An UML2 project based implementation of the UML 2.x specification
A base for modeling tools to build upon
With support for UML Profiles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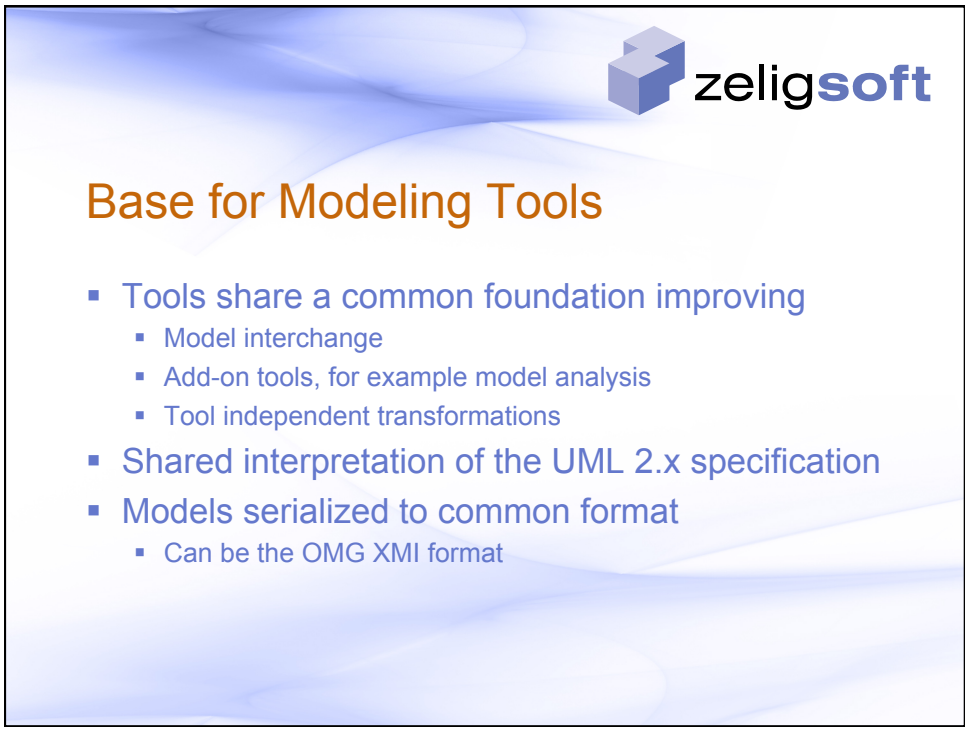
EMF Implementation of UML2 Spec
What many consider the reference implementation for the UML 2 specification
Metamodel completely specified as an Eclipse UML2 model
Support for many of the UML techniques
Redefinition
Subsetting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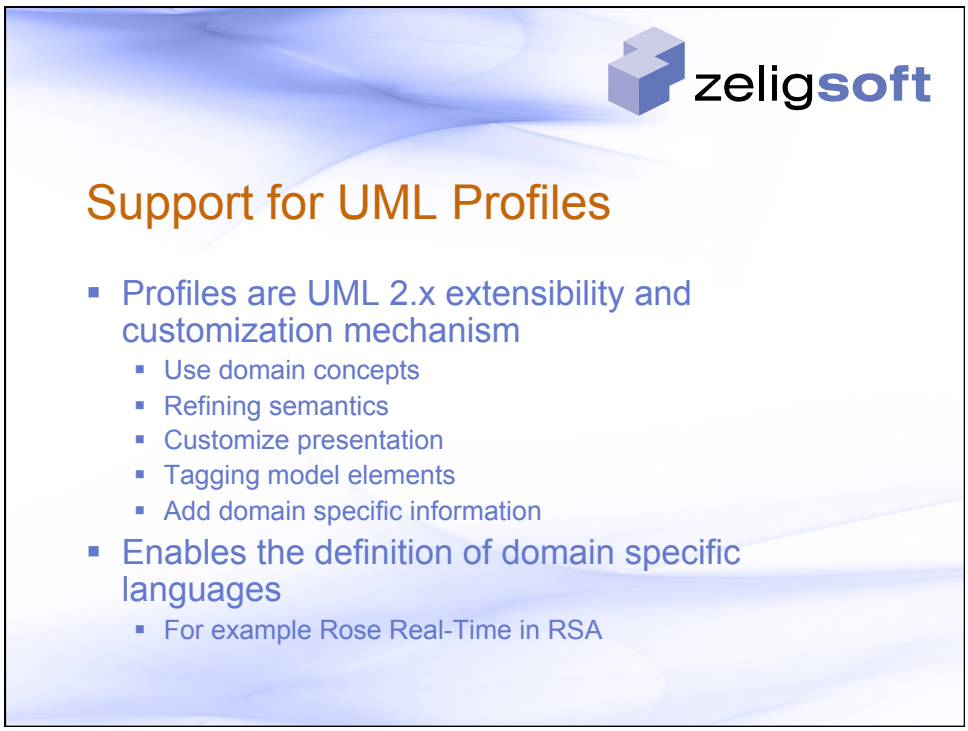
Base for Modeling Tools
Tools share a common foundation improving
Model interchange
Add-on tools, for example model analysis
Tool independent transformations
Shared interpretation of the UML 2.x specification
Models serialized to common format
Can be the OMG XMI format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Support for UML Profiles
Profiles are UML 2.x extensibility and customization mechanism
Use domain concepts
Refining semantics
Customize presentation
Tagging model elements
Add domain specific information
Enables the definition of domain specific languages
For example Rose Real-Time in RSA

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Creating a UML model

- Default editor
  - Tree based editor
- Rational Modeling Platform
  - Visual modeling
- Programmatically
  - Use the Factory for the UML 2 model

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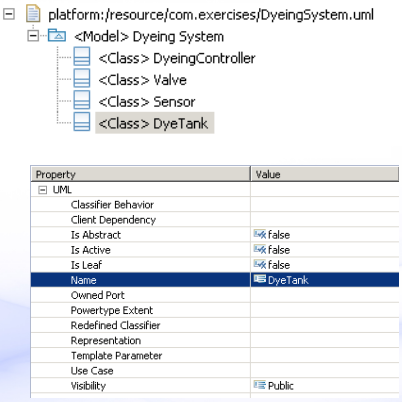
UML Model Editor

- **File → New...** from the main menu
- Select UML Model
  - Under Example EMF Model Creation Wizards
- Provide a name
- Set Model Object to Model
- Open with UML Model Editor
- Use Create Child in the context menu to create model elements



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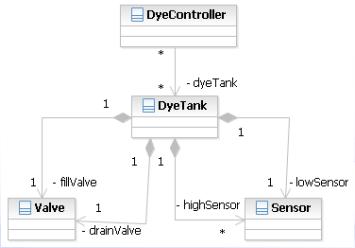
Rational Modeling Platform

- Create a UML 2 model graphically
- How to
  - File → New... from the main menu
  - UML Model
    - Under Modeling
  - Set the model name
- Create elements using diagrams and project explorer
- Created model can be opened in the UML Model Editor



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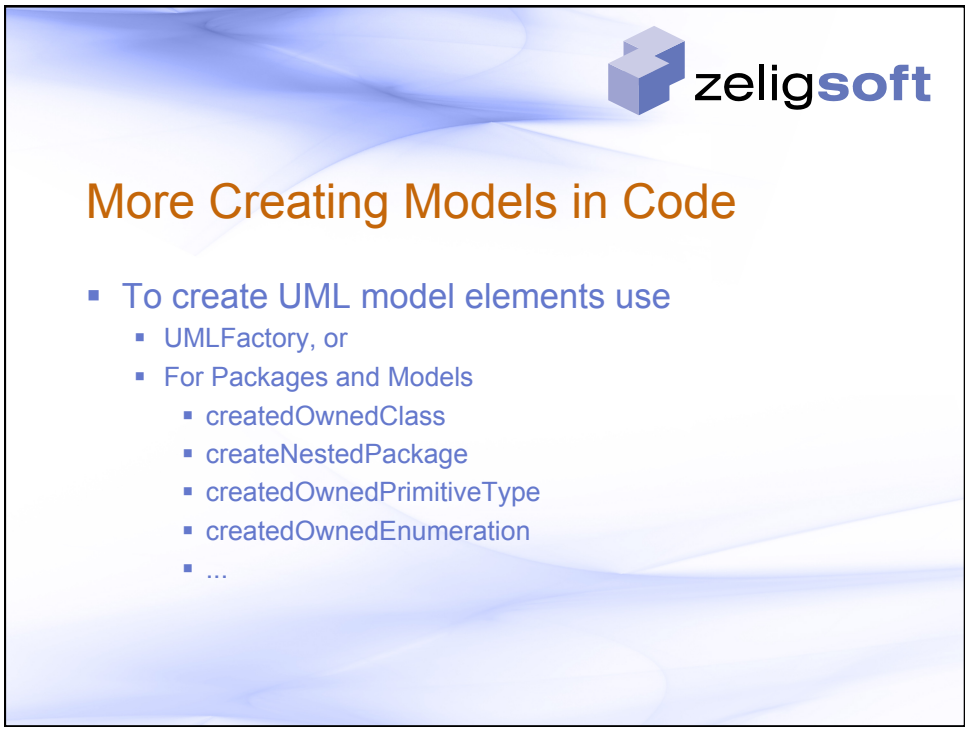
Creating Models in Code

- Programmatically create UML models and elements
- Use of the standard EMF generated API
- EMF reflective capabilities available

```
// Create resource to add model to
ResourceSet resourceSet = new ResourceSetImpl();
Resource modelResource
    = resourceSet.createResource(URI.createURI("dyeingSystem.uml", true));

// Create UML model and set name
Model dyeingSystemModel = UMLFactory.eINSTANCE.createModel();
dyeingSystemModel.setName("DyeingSystem");

// Add model to the resource
modelResource.getContents().add(dyeingSystemModel);
```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More Creating Models in Code
To create UML model elements use
UMLFactory, or
For Packages and Models
createdOwnedClass
createNestedPackage
createdOwnedPrimitiveType
createdOwnedEnumeration
...


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Persistence and Serialization
Models are persisted in an XMI compliant format
Tools built on top of UML2 project should be able to load the model
Likely won't maintain diagrams
<?xml version="1.0" encoding="UTF-8"?>
<uml:Model xmi:version="2.1" xmlns:xmi="http://schema.omg.org/spec/XMI/2.1"
xmlns:uml="http://www.eclipse.org/uml2/2.1.0/UML" xmi:id="_AjSRsJutEd2e__u-cIXQ8Q" name="Dyeing System">
<packagedElement xmi:type="uml:Class" xmi:id="_P7Ds8JutEd2e__u-cIXQ8Q" name="DyeingController"/>
<packagedElement xmi:type="uml:Class" xmi:id="_UaWiwJutEd2e__u-cIXQ8Q" name="Valve"/>
<packagedElement xmi:type="uml:Class" xmi:id="_XswusJutEd2e__u-cIXQ8Q" name="Sensor"/>
<packagedElement xmi:type="uml:Class" xmi:id="_cTgQUJutEd2e__u-cIXQ8Q" name="DyeTank"/>
</uml:Model>


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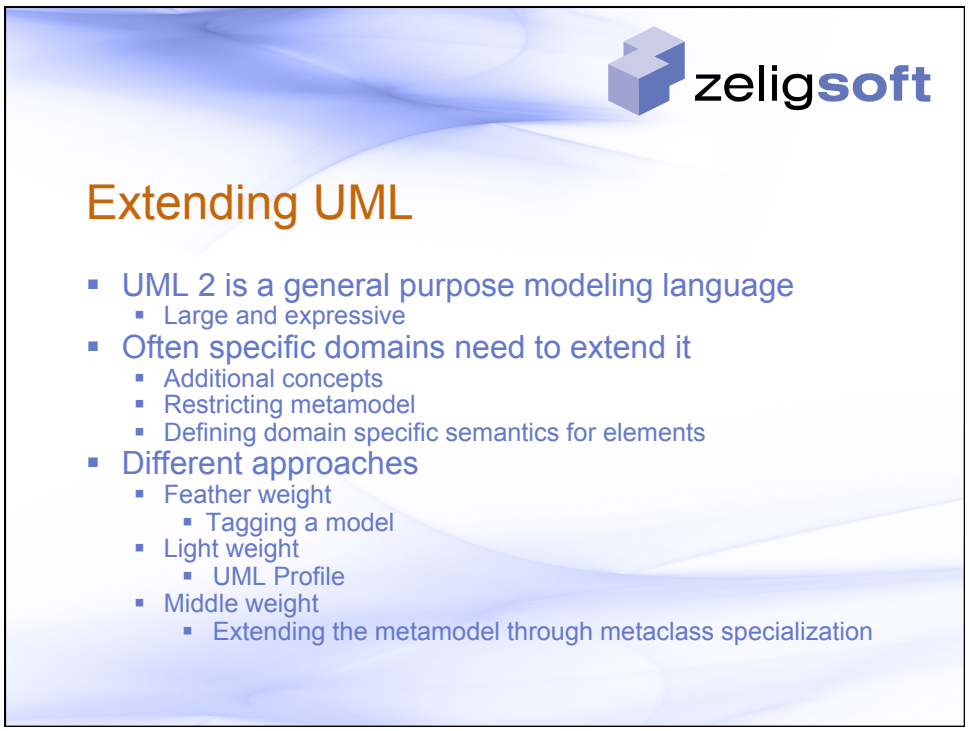
Summary
In this module we explored
What the UML2 project is
How to create UML2 models
UML Model Editor
Rational Modeling Platform
Through code
Persistence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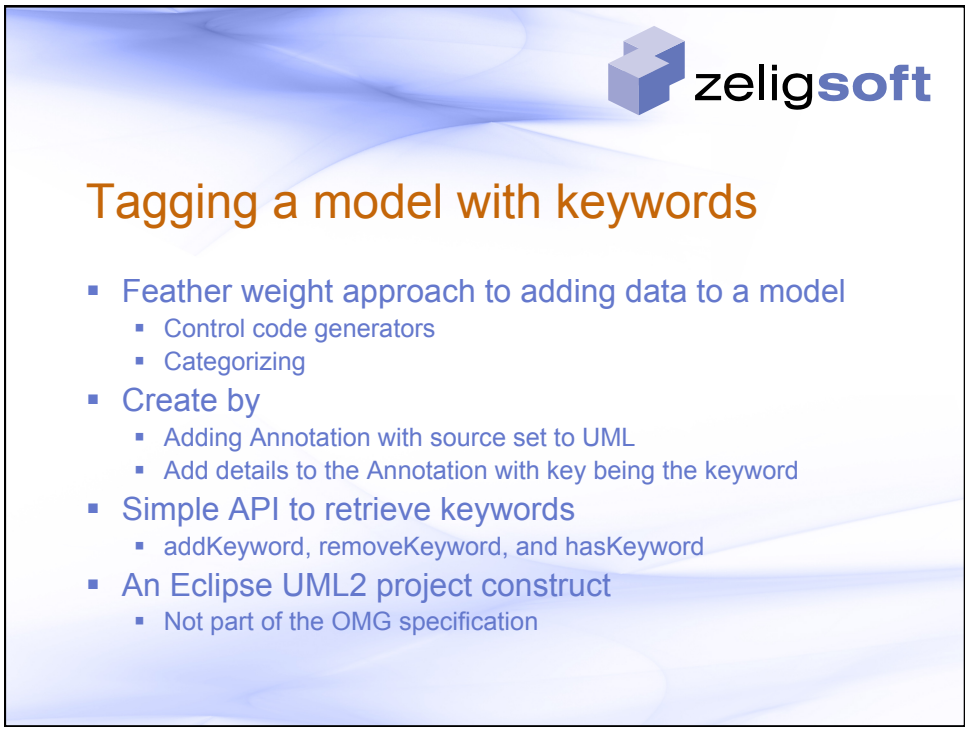
Extending UML
UML 2 is a general purpose modeling language
Large and expressive
Often specific domains need to extend it
Additional concepts
Restricting metamodel
Defining domain specific semantics for elements
Different approaches
Feather weight
Tagging a model
Light weight
UML Profile
Middle weight
Extending the metamodel through metaclass specialization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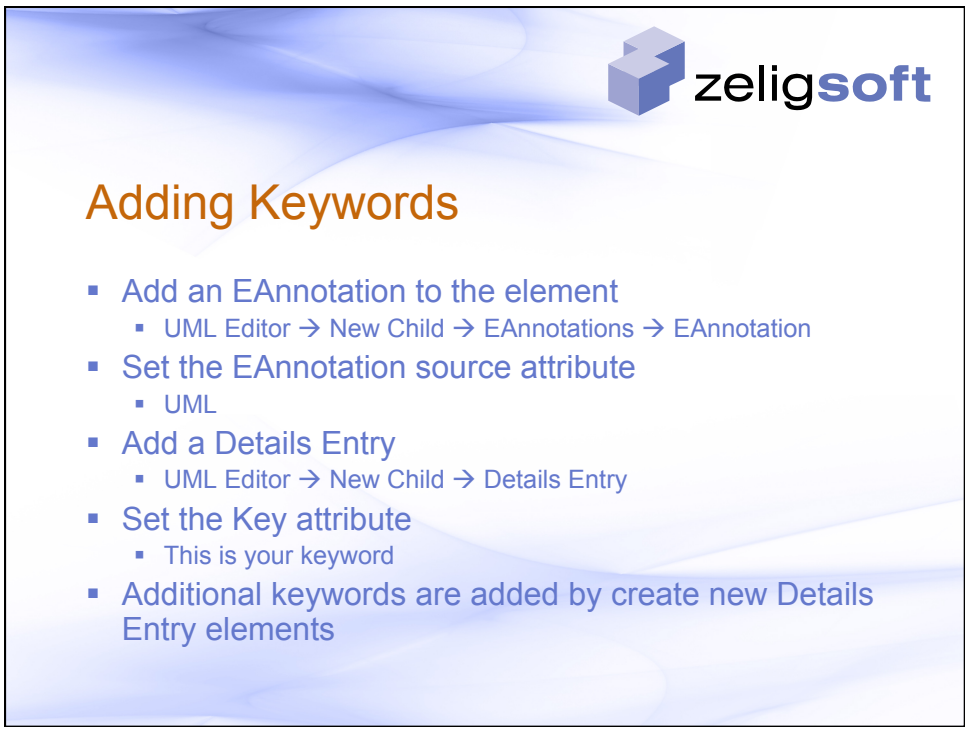
Tagging a model with keywords
Feather weight approach to adding data to a model
Control code generators
Categorizing
Create by
Adding Annotation with source set to UML
Add details to the Annotation with key being the keyword
Simple API to retrieve keywords
addKeyword, removeKeyword, and hasKeyword
An Eclipse UML2 project construct
Not part of the OMG specification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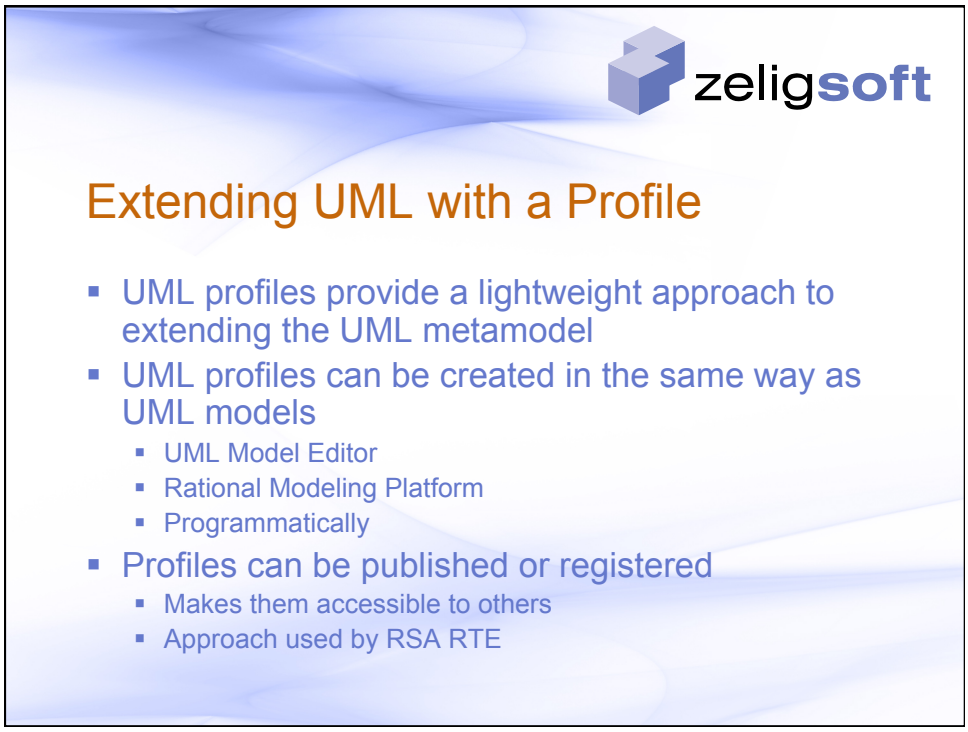
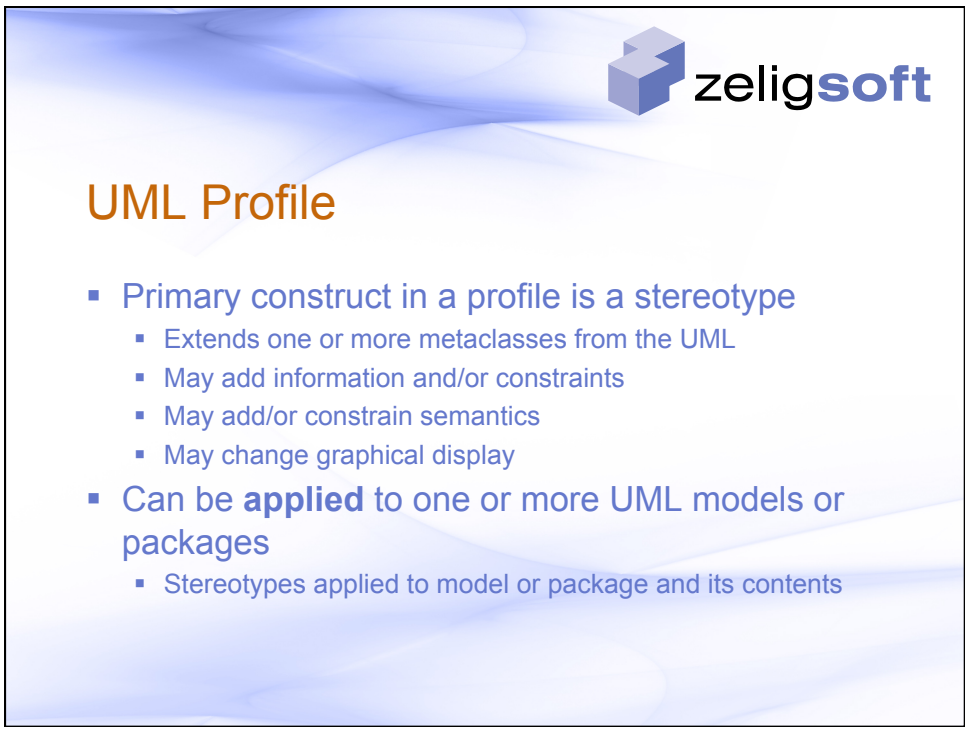
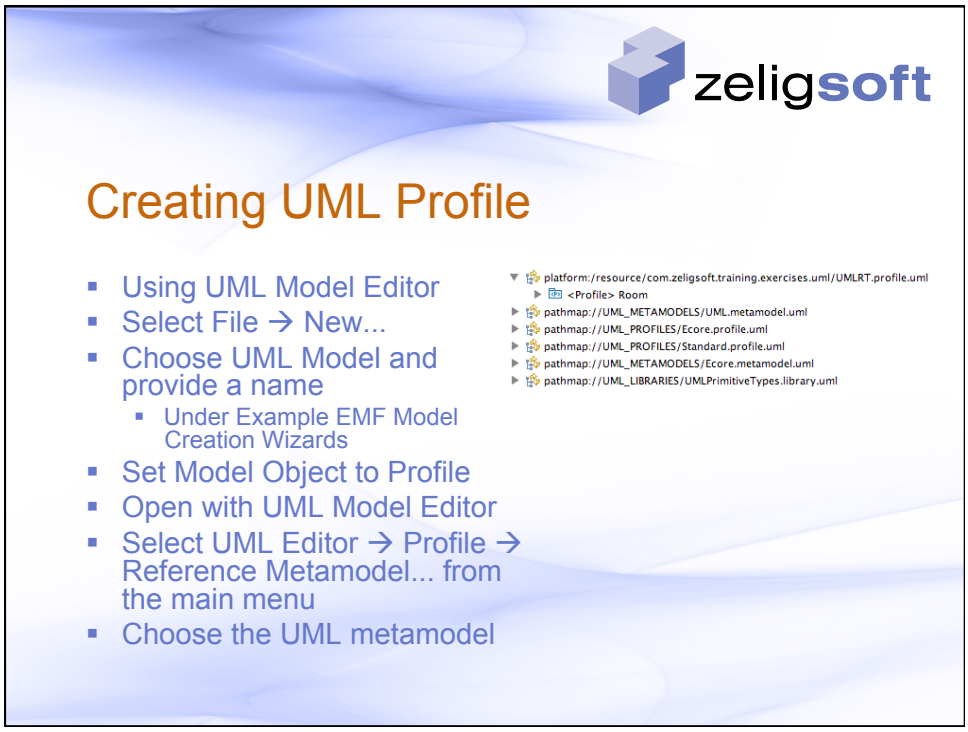
Adding Keywords
Add an EAnnotation to the element
UML Editor → New Child → EAnnotations → EAnnotation
Set the EAnnotation source attribute
UML
Add a Details Entry
UML Editor → New Child → Details Entry
Set the Key attribute
This is your keyword
Additional keywords are added by create new Details Entry elements





Toby McClean, Zeligsoft, 2008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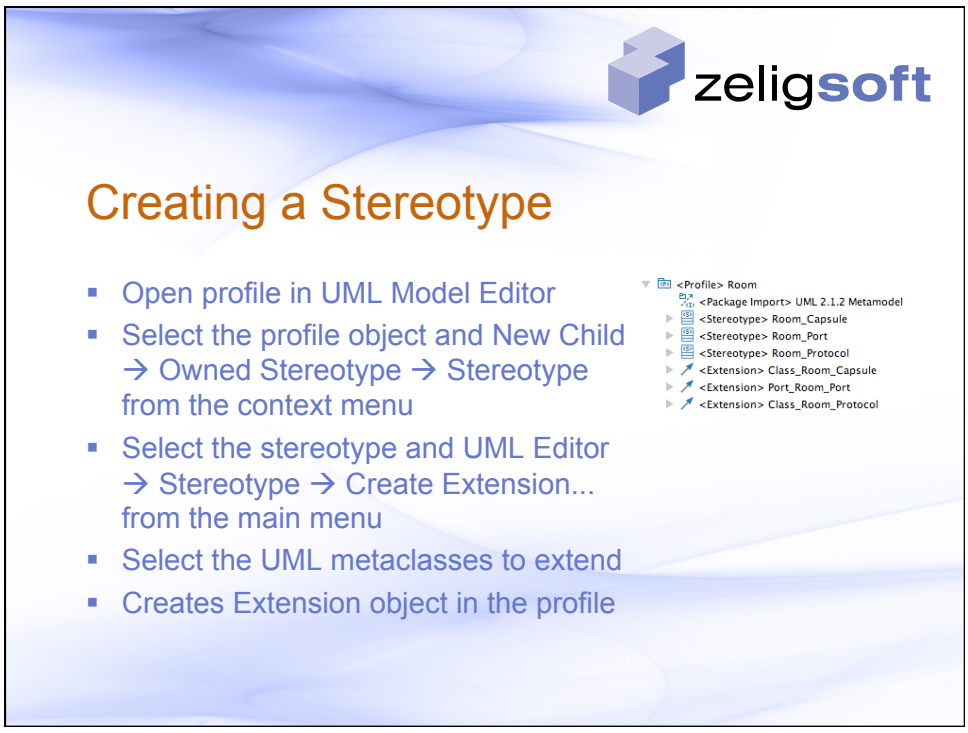
Creating UML Profile
Using UML Model Editor
Select File → New...
Choose UML Model and provide a name
Under Example EMF Model Creation Wizards
Set Model Object to Profile
Open with UML Model Editor
Select UML Editor → Profile → Reference Metamodel... from the main menu
Choose the UML metamodel
platform:/resource/com.zeligsoft.training.exercises.uml/UMLRT.profile.uml
<Profile> Room
pathmap://UML_METAMODELS/UML.metamodel.uml
pathmap://UML_PROFILES/Ecore.profile.uml
pathmap://UML_PROFILES/Standard.profile.uml
pathmap://UML_METAMODELS/Ecore.metamodel.uml
pathmap://UML_LIBRARIES/UMLPrimitiveTypes.library.uml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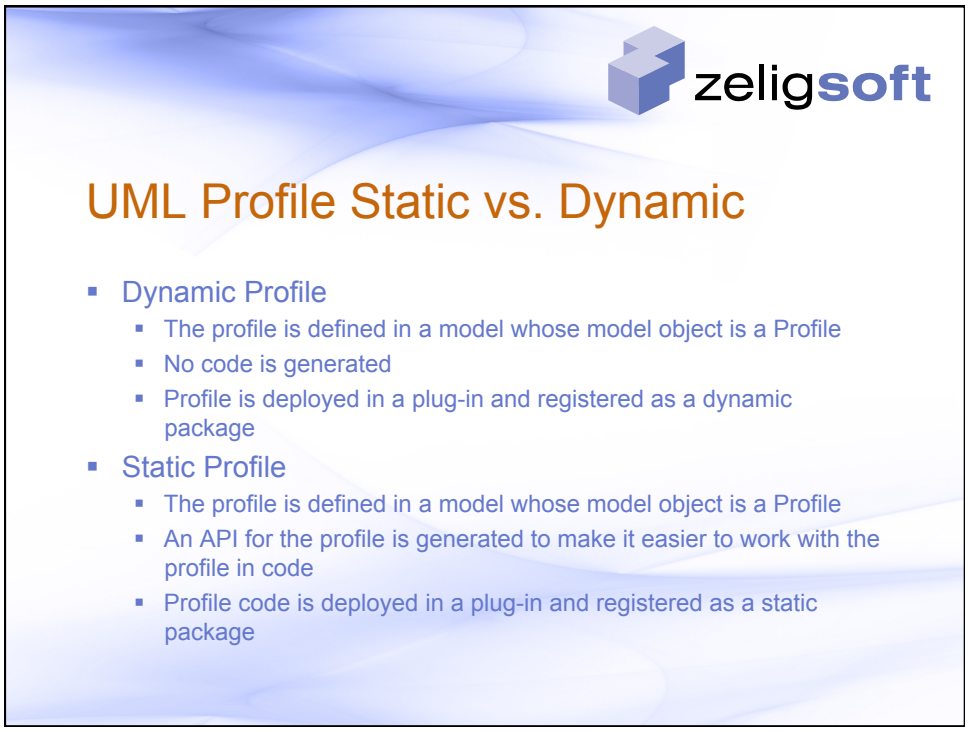
Creating a Stereotype
Open profile in UML Model Editor
Select the profile object and New Child → Owned Stereotype → Stereotype from the context menu
Select the stereotype and UML Editor → Stereotype → Create Extension... from the main menu
Select the UML metaclasses to extend
Creates Extension object in the profile
<Profile> Room
<Package Import> UML 2.1.2 Metamodel
<Stereotype> Room_Capsule
<Stereotype> Room_Port
<Stereotype> Room_Protocol
<Extension> Class_Room_Capsule
<Extension> Port_Room_Port
<Extension> Class_Room_Protocol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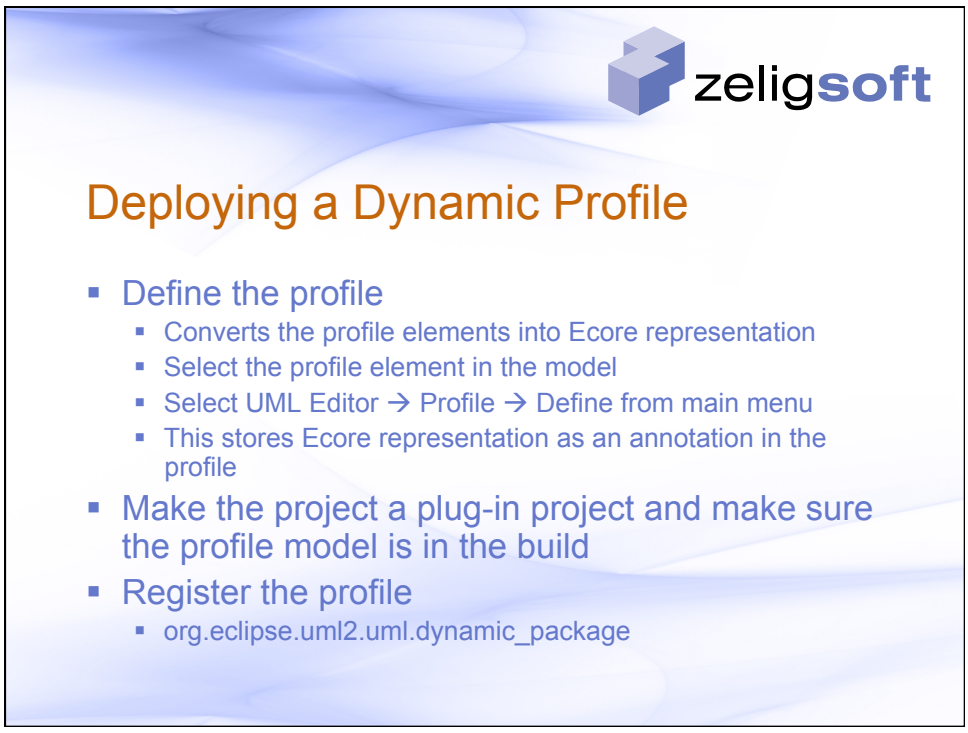
UML Profile Static vs. Dynamic
Dynamic Profile
The profile is defined in a model whose model object is a Profile
No code is generated
Profile is deployed in a plug-in and registered as a dynamic package
Static Profile
The profile is defined in a model whose model object is a Profile
An API for the profile is generated to make it easier to work with the profile in code
Profile code is deployed in a plug-in and registered as a static package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Deploying a Dynamic Profile
Define the profile
Converts the profile elements into Ecore representation
Select the profile element in the model
Select UML Editor → Profile → Define from main menu
This stores Ecore representation as an annotation in the profile
Make the project a plug-in project and make sure the profile model is in the build
Register the profile
org.eclipse.uml2.uml.dynamic_package


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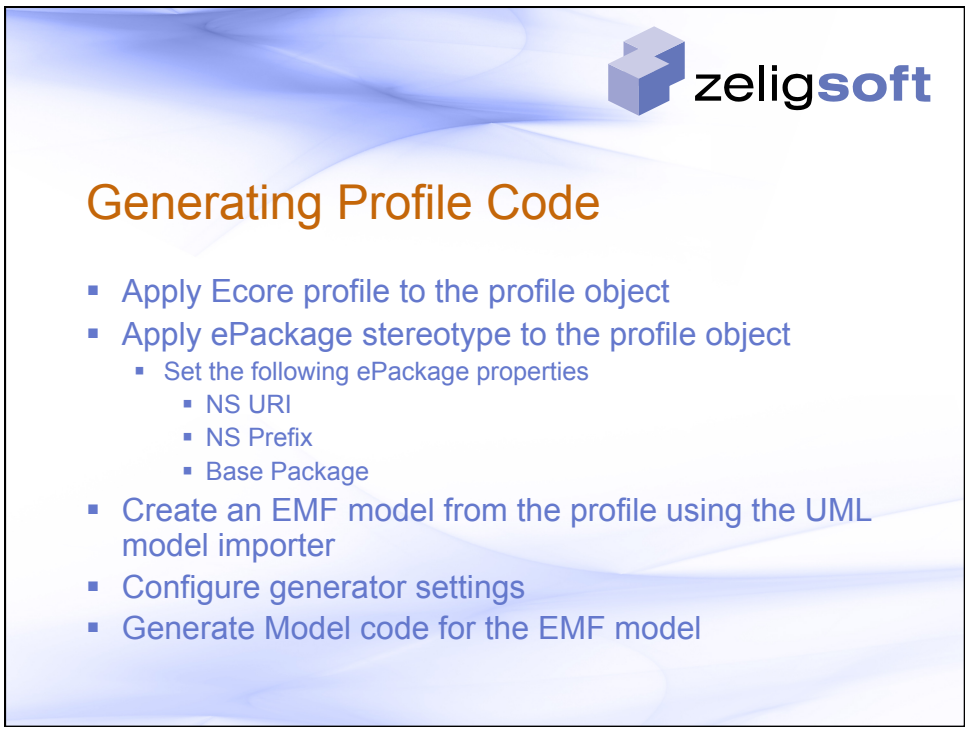
Deploying a Static Profile
Generate the profile code
Requires creating an EMF representation of the profile
Make the project a plug-in project
Include the generated code and the profile model
Register the profile
org.eclipse.uml2.uml.generated_package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Generating Profile Code
Apply Ecore profile to the profile object
Apply ePackage stereotype to the profile object
Set the following ePackage properties
NS URI
NS Prefix
Base Package
Create an EMF model from the profile using the UML model importer
Configure generator settings
Generate Model code for the EMF model

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Discussion

- Examples from your experience?
  - Additional information?
  - Additional concepts?
- Does this impact modeling, validation or generation?

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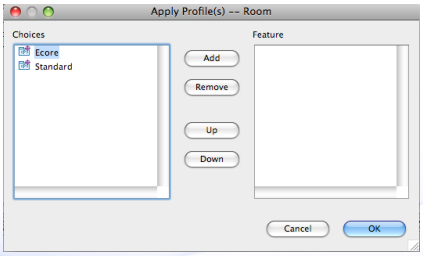
Applying a UML profile

- A Profile is applied to a Model, Profile or Package
- Open model in UML Model Editor
- Select model or package object and UML Editor → Package → Apply Profile... from the main menu
- Choose the profiles to apply
- Creates a Profile Application object in the package



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Applying a UML Profile - Code

```
// Load the resource containing the profile
Resource roomProfileResource
    = resourceSet.getResource(ROOM_PROFILE_URI, true);
Profile roomProfile =
    (Profile) roomProfileResource.getContents().get(0);

// Apply the profile to a model
dyeingSystemModel.applyProfile(roomProfile);
```

Implementation details

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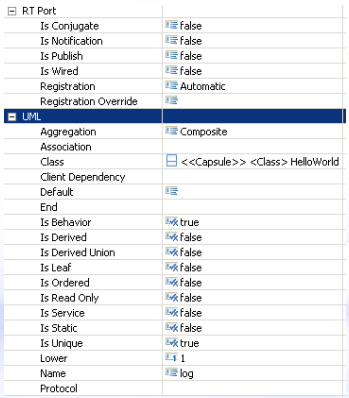
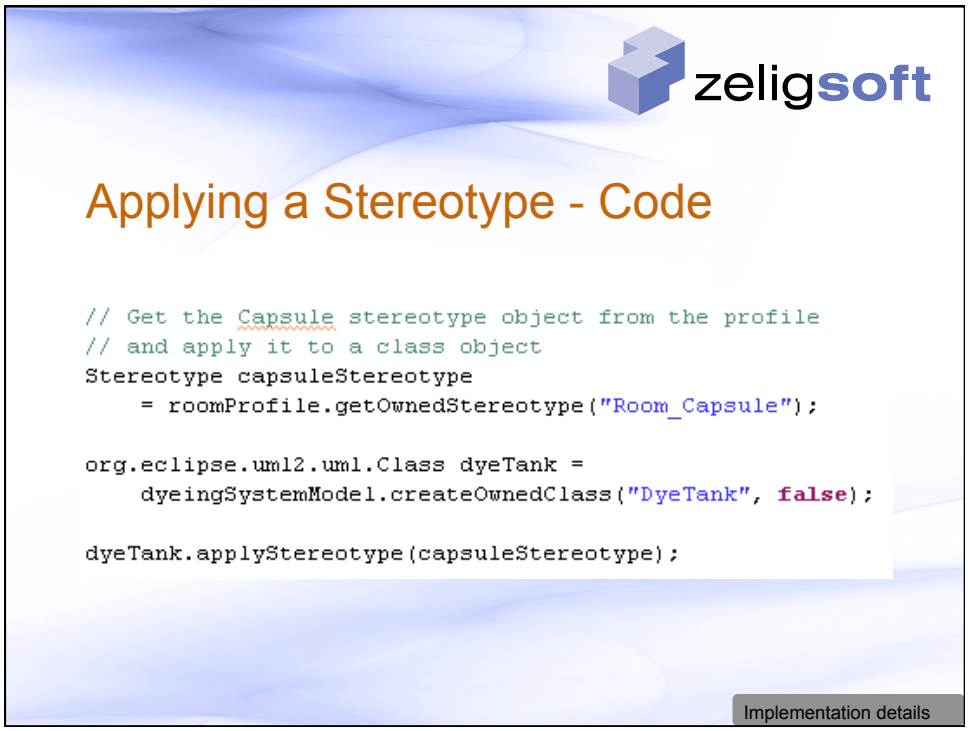
Applying a Stereotype

- Stereotypes are applied to elements in a model
  - More than one can be applied
  - Applicable elements defined by Stereotypes metaclass extensions
  - Attributes of Stereotypes can be set in the properties view of the UML Model Editor
- Select the element in the editor and UML Editor → Element → Apply Stereotype... from the main menu

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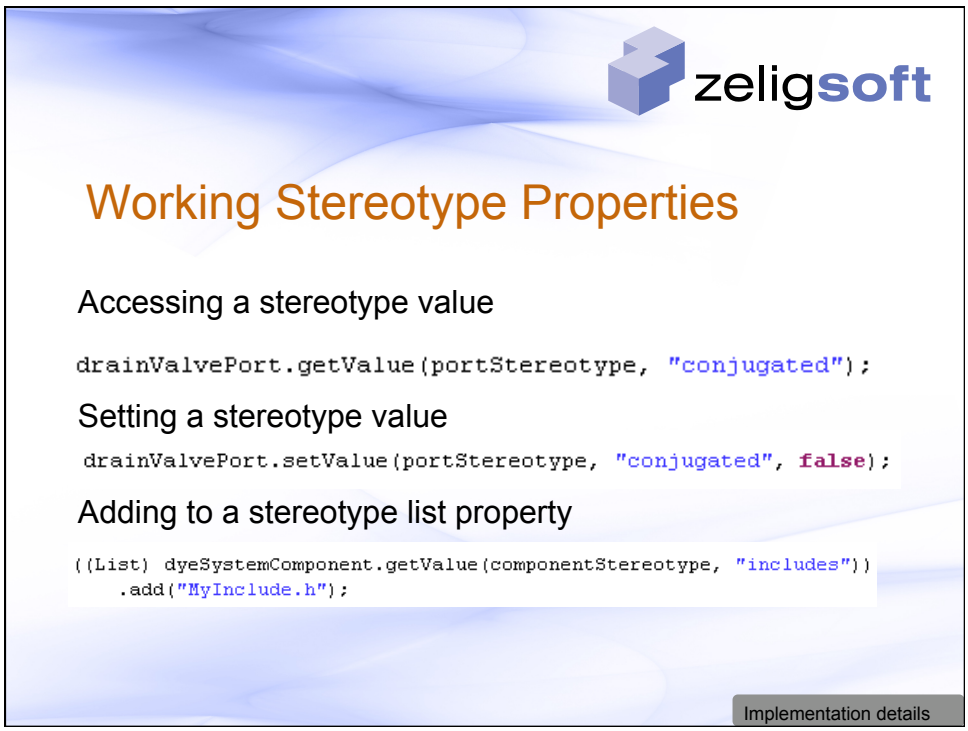
Applying a Stereotype - Code
// Get the Capsule stereotype object from the profile
// and apply it to a class object
Stereotype capsuleStereotype
= roomProfile.getOwnedStereotype("Room_Capsule");
org.eclipse.uml2.uml.Class dyeTank =
dyeingSystemModel.createOwnedClass("DyeTank", false);
dyeTank.applyStereotype(capsuleStereotype);
Implementation details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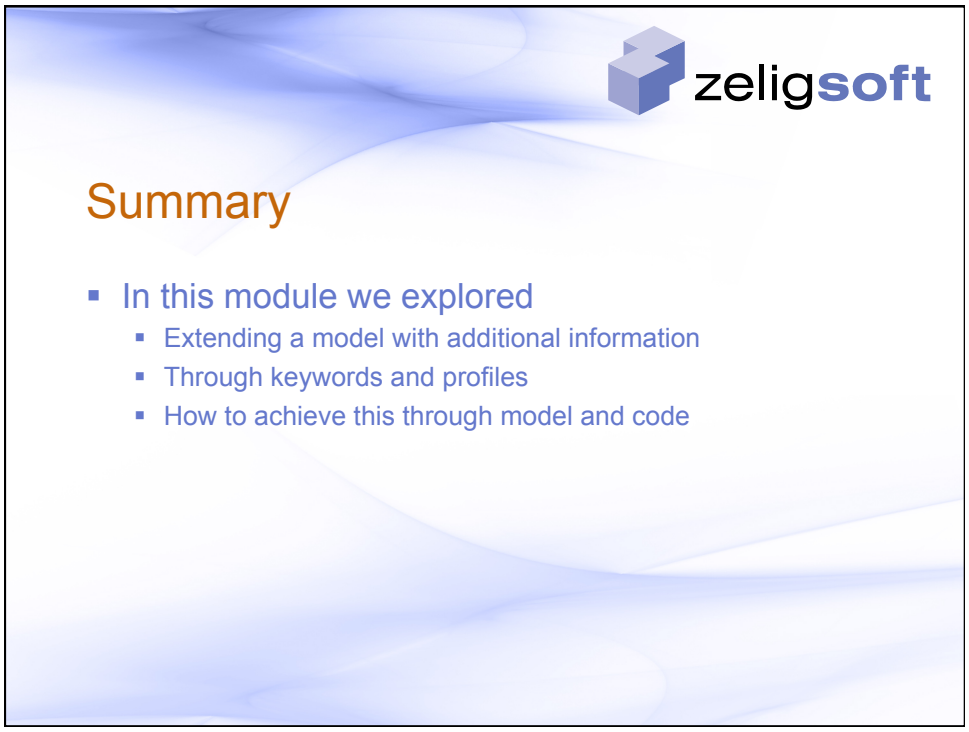
Working Stereotype Properties
Accessing a stereotype value
drainValvePort.getValue(portStereotype, "conjugated");
Setting a stereotype value
drainValvePort.setValue(portStereotype, "conjugated", false);
Adding to a stereotype list property
((List) dyeSystemComponent.getValue(componentStereotype, "includes"))
.add("MyInclude.h");
Implementation details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Summary
In this module we explored
Extending a model with additional information
Through keywords and profiles
How to achieve this through model and code


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Keywords in RSA-RTE
General
Profiles
Stereotypes
Documentation
Constraints
Capabilities
Relationships
Keywords:
Applied Stereotypes:
Stereotype
Profile
Required
modelLibr...
Standard
False
RTModel
UMLRealTime
True
Apply Stereotypes...
Unapply Stereotypes

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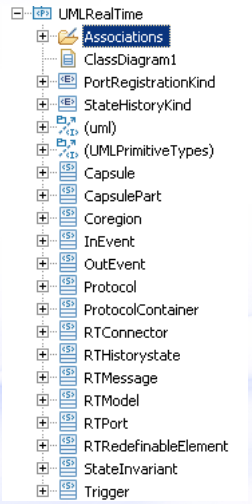
Profiles in RSA-RTE

- Profiles are used extensively in RSA-RTE
  - Extending/constraining the UML to UML-RT semantics and notation
    - UMLRealTime profile
    - UMLRealTime model libraries for things like Frame, and Log
  - Adding information to model elements to generate code
    - C++ support through CPPPropertySets profile
    - C++ model libraries for
- When a RSA-RTE model is created
  - UMLRealTime profile is applied
  - CPPPropertySets profile is applied
  - RTClasses, RTComponents and CPPPrimitiveDatatypes libraries



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Creating Profiles in RSA-RTE

- Model the domain
  - Concepts, attributes and relationships in a Profile
  - Complimentary model libraries
  - Constraints - OCL or Java
- Publish the Profile
  - Helps RSA-RTE with versioning and migration
- Register the Profile in a plug-in
  - Make it available for RSA-RTE to apply it
- Can export to open source UML 2

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Creating Profiles in RSA-RTE

- File → New → Other…
- Select UML Profile or UML Profile Project…
  - Under Modeling → UML Extensibility
- Set name and import the UML Primitive Types library
- Creates a Profile object that already imports the UML metamodel
- Add stereotypes, classes and relationships

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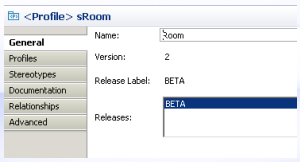
Releasing a Profile

- RSA-RTE provides a release capability for profiles
  - A released profile is to be additive otherwise backwards compatibility may not work
- To release a profile
  - Select Release in the context menu of the profile object
  - Associate a label with the release
  - Be careful how often a profile is released



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Publishing a Profile

- Publishing a profile makes it available for others to install and use in their RSA-RTE models
- To publish
  - Make the project a plug-in project
  - Add the profile file to the build
  - Extend “com.ibm.xtools.uml.msl.UMLProfiles”
    - Enables RSM to find the profile
  - Publish the plug-in

```
<extension point="com.ibm.xtools.uml.msl.UMLProfiles">
    <UMLProfile id="com.zeligsoft.exercises.profiles.room"
        name="ROOM"
        path="pathmap://EXERCISE_PROFILES/Room.epx" required="false" visible="true" />
</extension>
```

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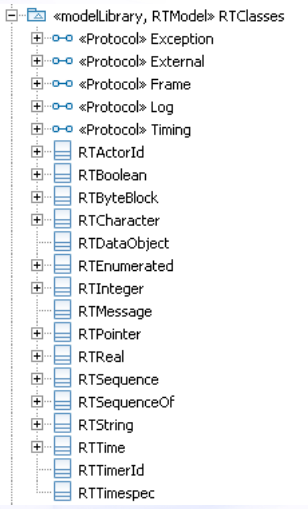
Model Libraries

- Model libraries provide a mechanism for publishing a set of model elements for reuse
  - e.g. Data types, reusable components
- It is a model with the modelLibrary stereotype applied
  - modelLibrary is part of the Standard profile
- The elements will be read-only in the model that imports the library



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Publishing a Model Library

- Publishing a model library makes it available for others to import and use in their RSA-RTE models
- To publish
  - Make the project a plug-in project
  - Add the model file to the build
  - Extends com.ibm.xtools.uml.msl.UMLLibraries
    - Enables RSM to find the profile
  - Publish the plug-in

```
<extension point="com.ibm.xtools.uml.msl.UMLLibraries">
   <UMLLibrary
         name="RoomServices"
         path="pathmap://EXERCISE_MODEL_LIBRARIES/RoomServices.emx">
   </UMLLibrary>
</extension>
```

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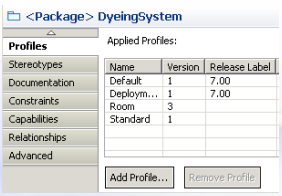
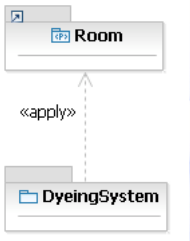
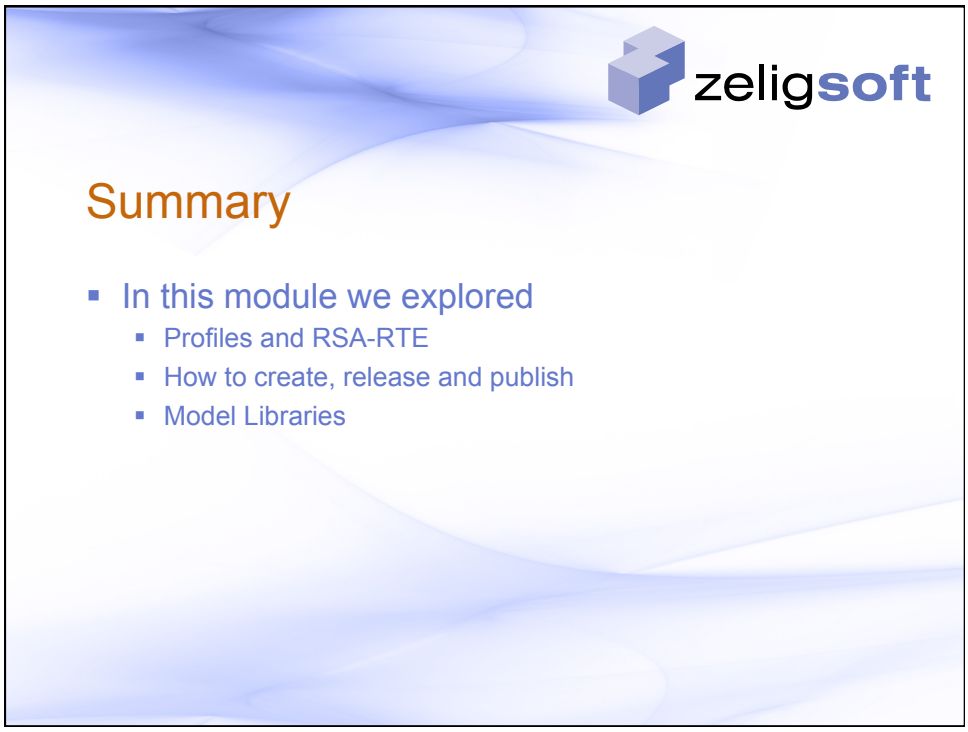
Applying Profiles in RSA-RTE

- On a Model or Package “Add Profile…”
- Apply Stereotype to Elements in the model
- Set attributes of the Stereotype
  - Advanced tab
  - Stereotype tab



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Summary
In this module we explored
Profiles and RSA-RTE
How to create, release and publish
Model Libraries


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Discussion
Any RSA-RTE concepts you would add/remove?

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Questions

Toby McClean, Zeligsoft, 2008


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Goals
After this module you will have
An understanding of the main transformation technologies
Understand their applicability
Be able to put simple transformations together


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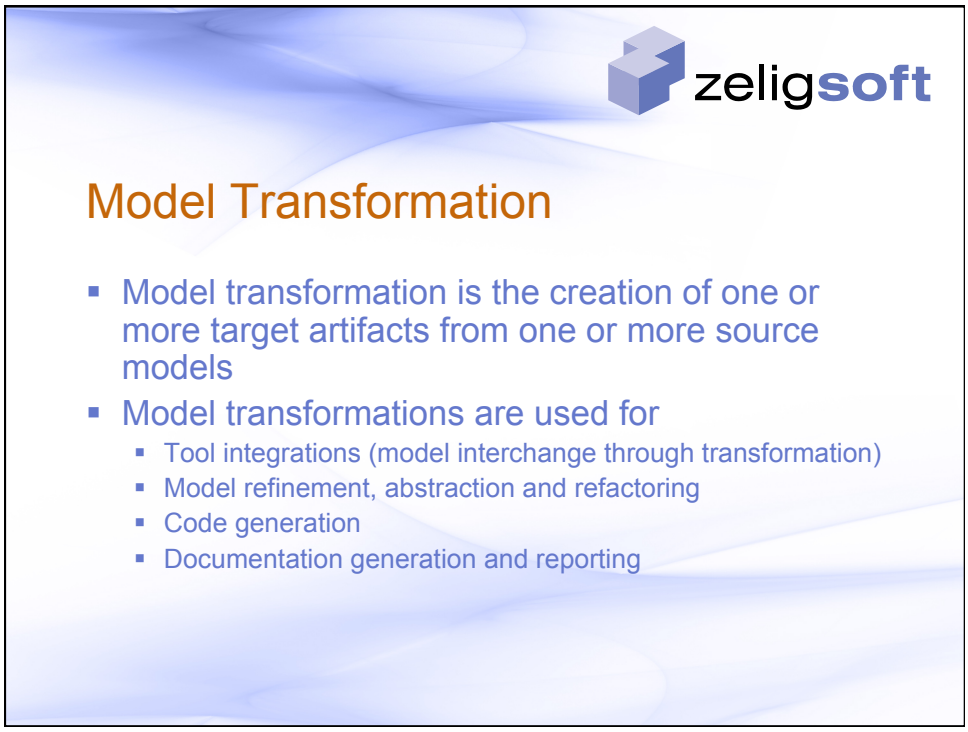
Agenda
Model transformation introduction
Model to model
Java
QVT
Model to text
xPand
xTend
JET
oAW



Toby McClean, Zeligsoft, 2008

Toby McClean, Zeligsoft, 2008

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Model to Text Transformations

- A M2T transformation creates one or more text based artifacts from one or more source model
- Typically template based
  - Create a template from an example of the desired artifact
- M2T consideration
  - Often it is best to use M2T with a source model that is dedicated to the transformation
- Eclipse technologies
  - M2T Project - **JET2** and **xPand**

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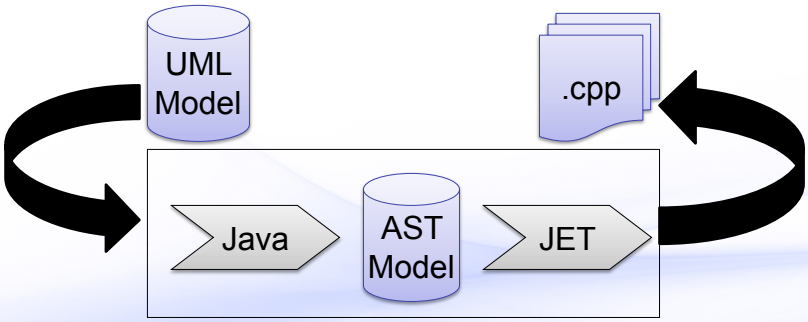
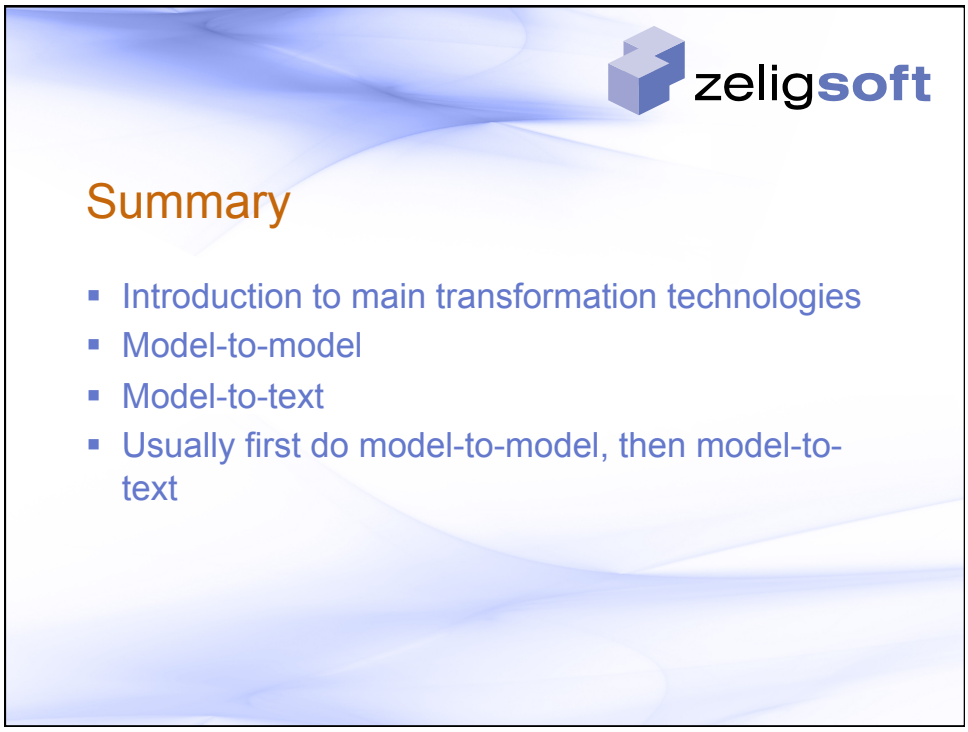
RSA RTE Transformation Workflow

Lets put this into context, RSA-RTE uses a M2M then M2T to generate code

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Summary
Introduction to main transformation technologies
Model-to-model
Model-to-text
Usually first do model-to-model, then model-to-text


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Discussion
What type of transformations could you imagine?
Some examples
Structural, in place
Capsule-to-class
Proxies
Bi-directional
Linking between system and design
Analysis
Walk the model and generate reports
Dependency, packaging violations


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Agenda
Model transformation introduction
Model to model
Java
QVT
Model to text
xPand
xTend
JET
oAW


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Eclipse Transformation Technologies
Model to Model Transformations

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Overview

- In this section we will explore the M2M technologies available in Eclipse
- The specific technologies are
  - Java
  - QVT

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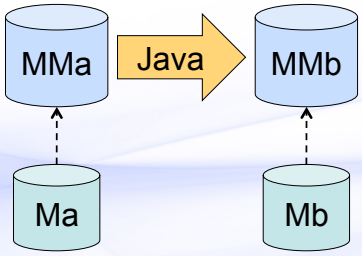
M2M with Java

- The most basic approach to M2M is to use straight Java with the EMF generated API
- Transformation writer has full power or a 3GL
  - Development tools
  - Debugging facilities
- Transformation written against meta-model
  - Executed against instance model



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Developing a Transformation

- Develop the transformation as if you were writing a Java application
- Model navigation
  - EMF Reflective API
  - Metamodel specific API generated by EMF
- Transformation rules
  - Rule constraints
  - Target element construction

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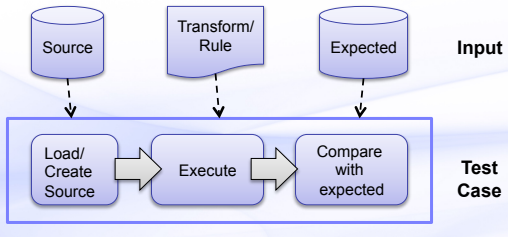
Testing Transformations

- Traditional Java test techniques
  - Hand crafted test framework
  - JUnit
- Using JUnit
  - Automatable
  - Repeatable



Toby McClean, Zeligsoft, 2008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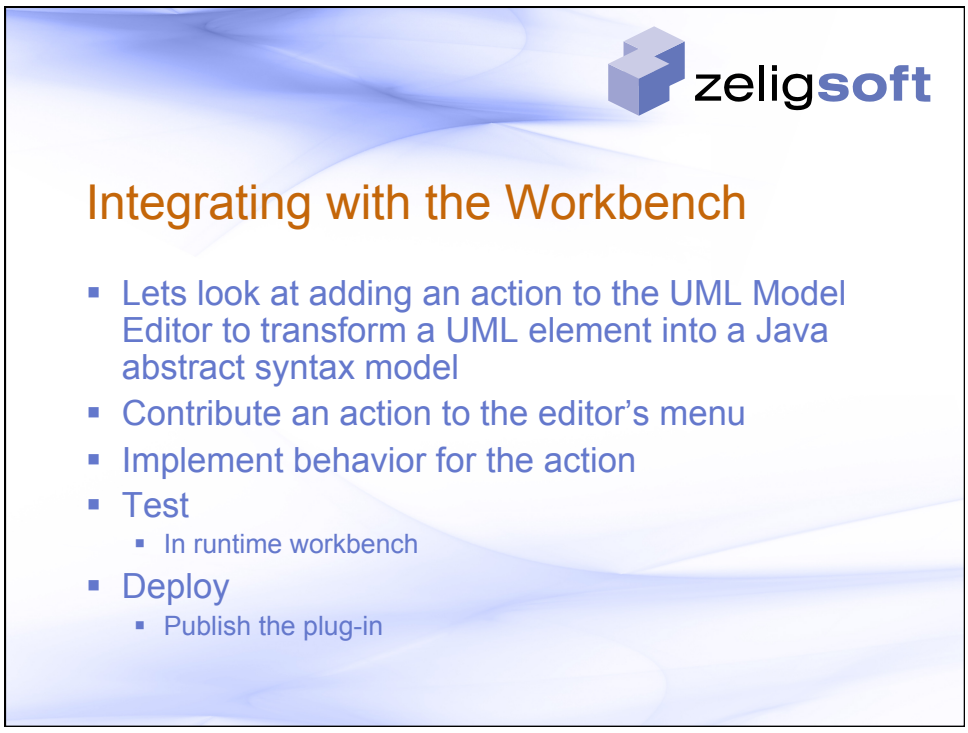
Executing the Transformation
Use workbench Java execution capabilities
We can use the Run As → Java Application
We can debug using Debug As → Java Application
To pass transformation parameter values
Use command line
Build a user interface
Integrate with workbench
Provide an action to invoke from editor and/or view
Provide a transformation resource with action to execute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Integrating with the Workbench
Lets look at adding an action to the UML Model Editor to transform a UML element into a Java abstract syntax model
Contribute an action to the editor's menu
Implement behavior for the action
Test
In runtime workbench
Deploy
Publish the plug-in

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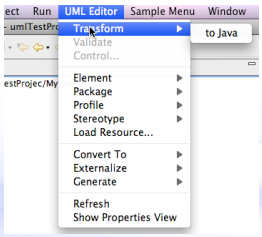
Contribute Action to the Editor

- UML Model Editor ID
  - org.eclipse.uml2.uml.editor.presentation.UMLEditorID
- Menu bar path
  - org.eclipse.uml2.umlMenuID
    - settings
    - actions
    - additions
    - additions-end



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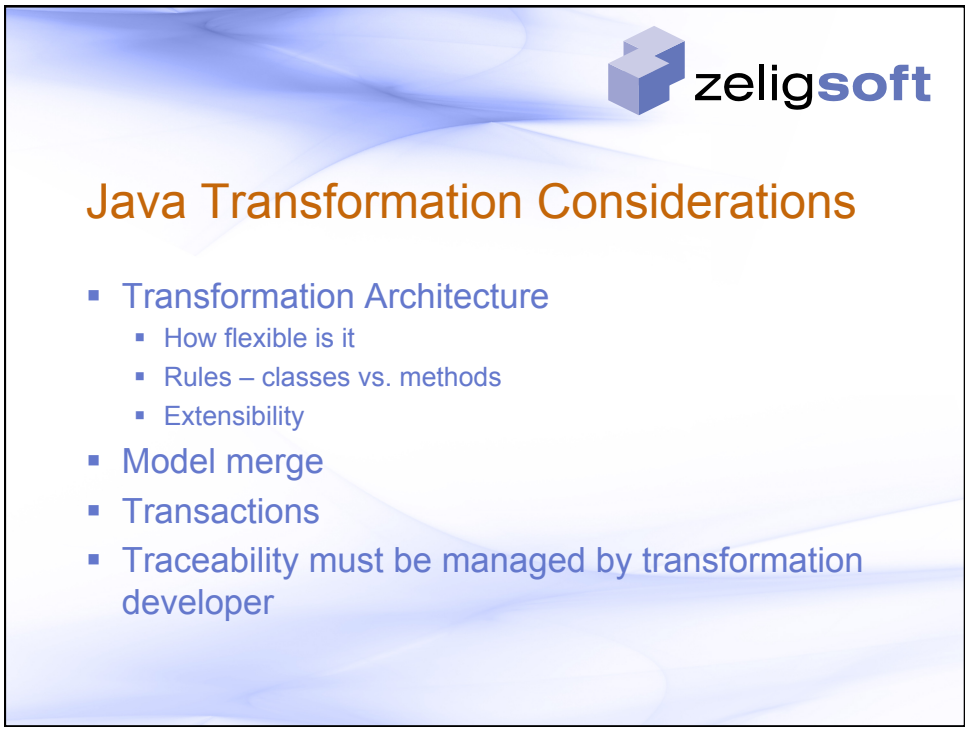
Integrating with RSA-RTE

- Contribute an action
  - to the Project Explorer context menu
  - to the Diagram Editor context menu
- Implement action handler
  - Implement IEditorActionDelegate
- Test
  - In runtime workbench
- Deploy
  - Publish the plug-in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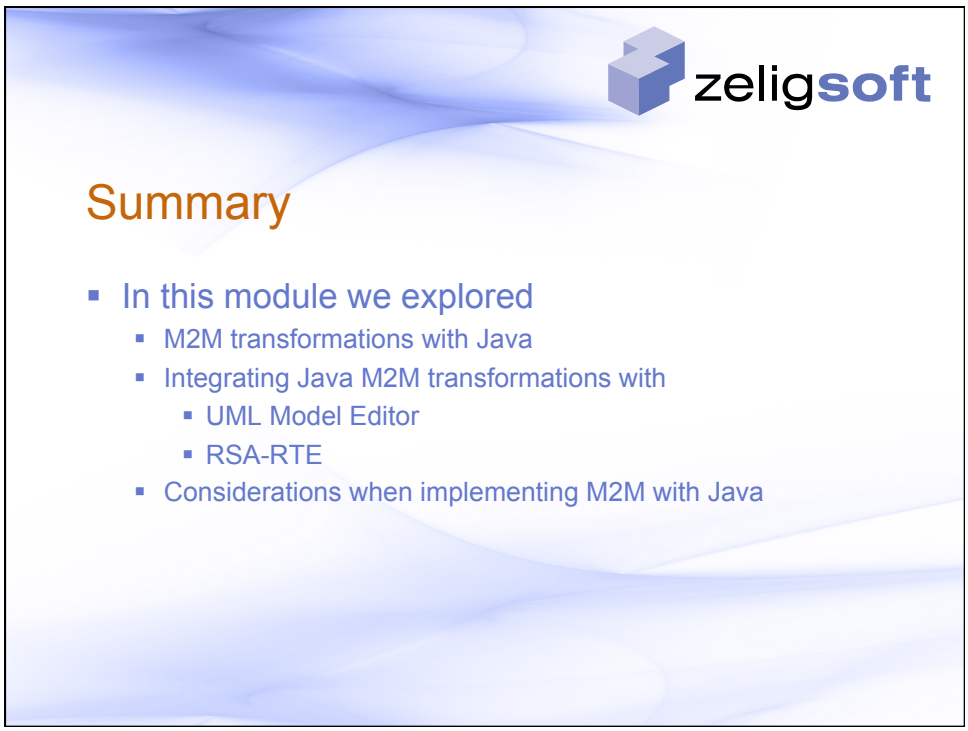
Java Transformation Considerations
Transformation Architecture
How flexible is it
Rules – classes vs. methods
Extensibility
Model merge
Transactions
Traceability must be managed by transformation developer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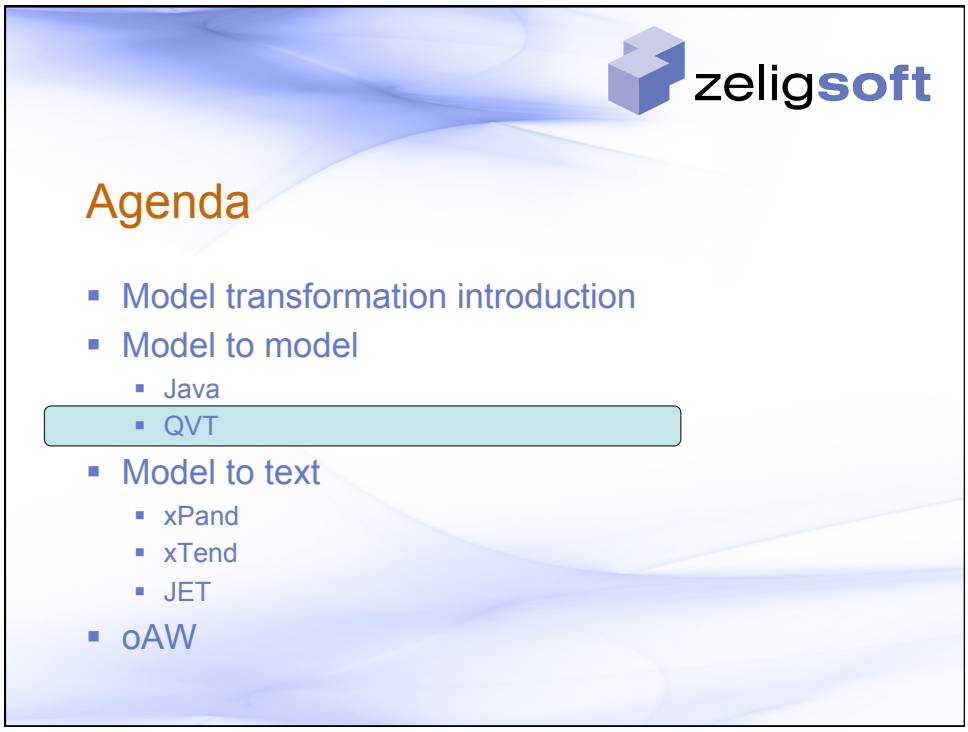
Summary
In this module we explored
M2M transformations with Java
Integrating Java M2M transformations with
UML Model Editor
RSA-RTE
Considerations when implementing M2M with Java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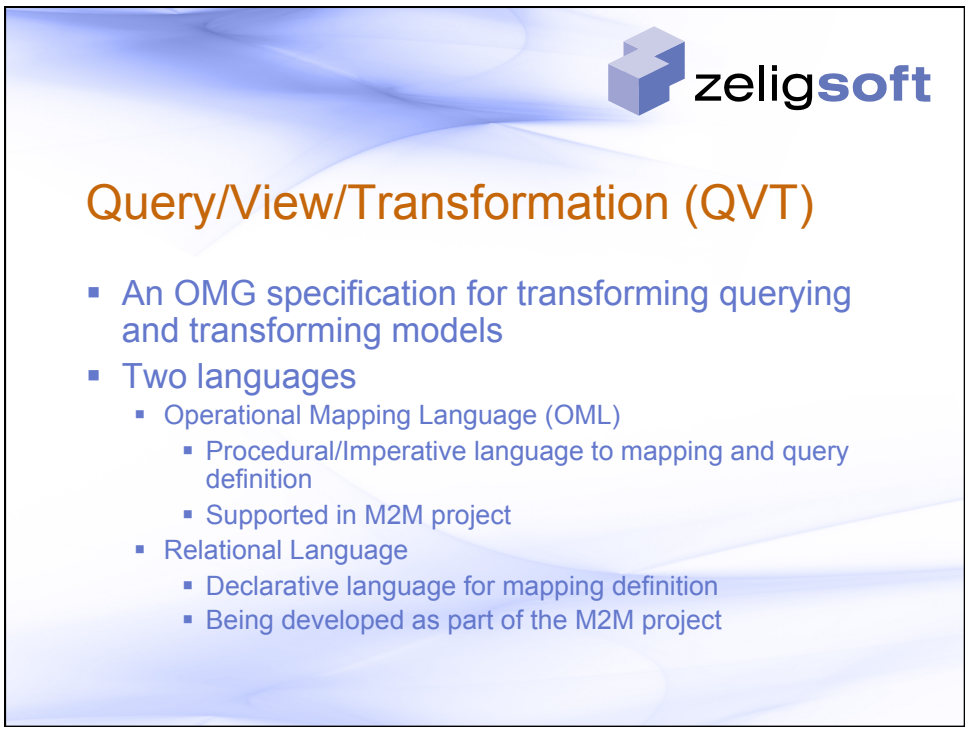
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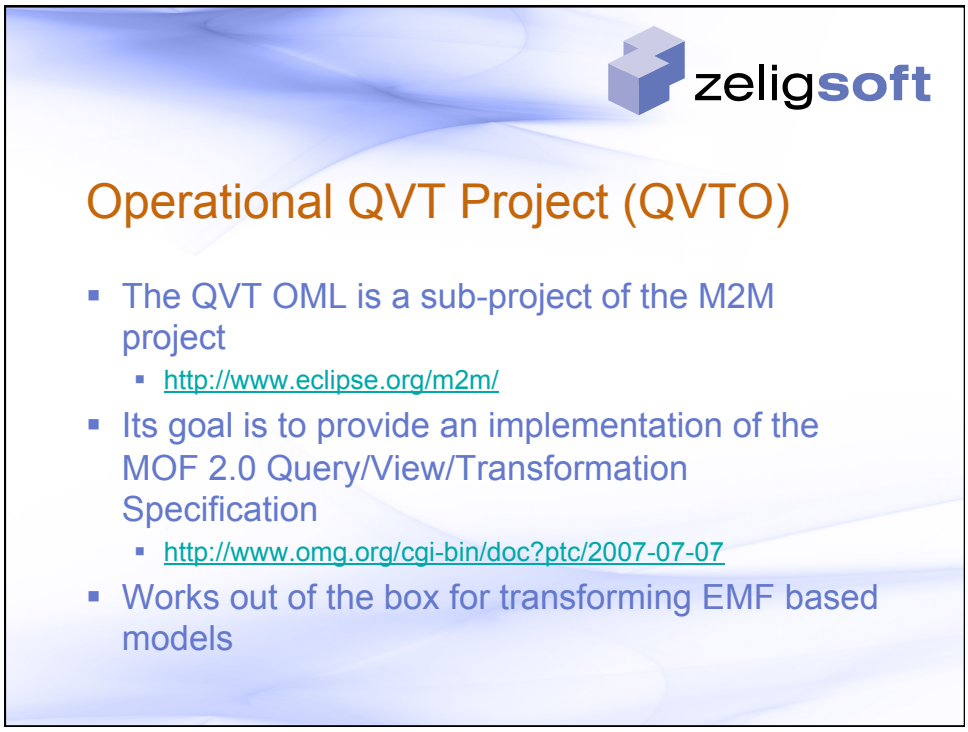
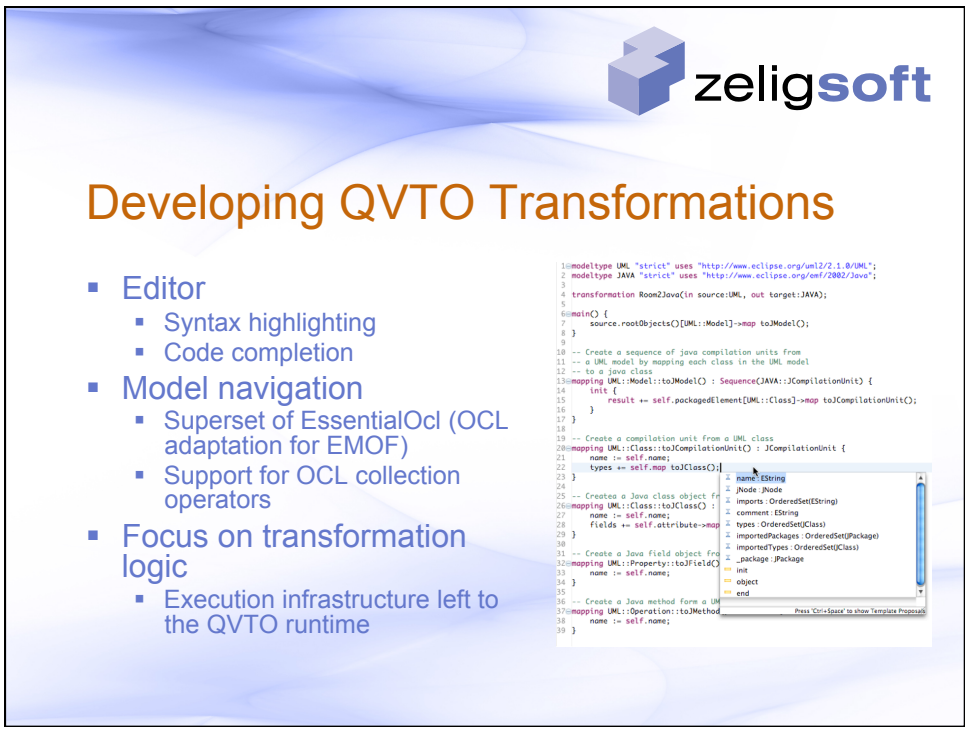
Query/View/Transformation (QVT)
An OMG specification for transforming querying and transforming models
Two languages
Operational Mapping Language (OML)
Procedural/Imperative language to mapping and query definition
Supported in M2M project
Relational Language
Declarative language for mapping definition
Being developed as part of the M2M project





Toby McClean, Zeligsoft, 2008

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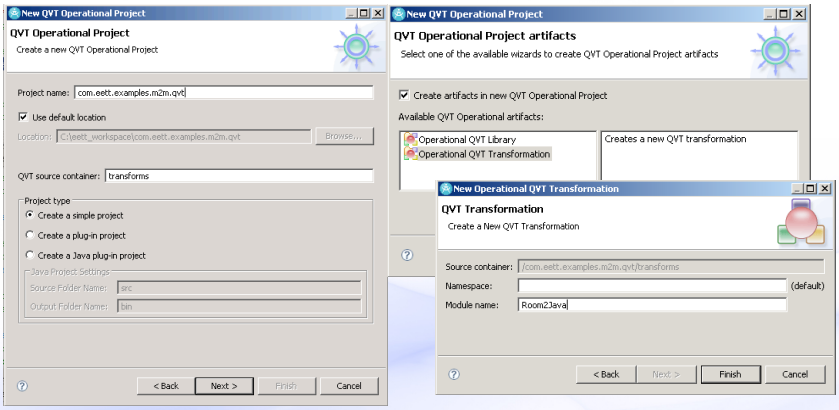
Developing QVTO Transformations



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Testing QVTO Transformations

- Same approach as Java transforamtions
- Traditional Java test techniques
  - Hand crafted test framework
  - JUnit
- Using JUnit
  - Automatable
  - Repeatable

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Executing QVTO Transformations

- The QVTO project integrates with the workbench Run framework
- Select the transformation resource in the project explorer
- Choose Run As → Run Configurations… from the context menu
- Create a new configuration under Operational QVT Interpreter
  - The transformation parameters is populated from the transformation module that is specified
  - The option to generate a trace file for debugging
  - The option to save the configuration for sharing

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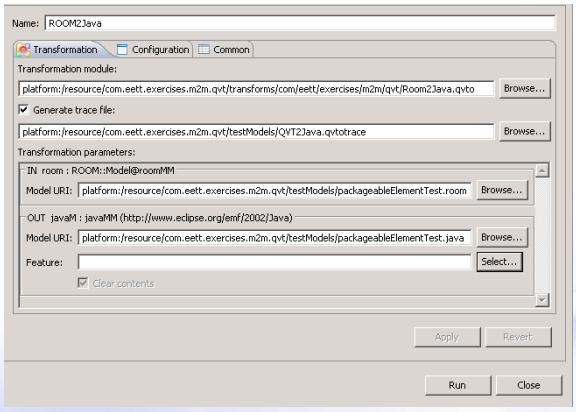
Executing QVTO Transformations



Toby McClean, Zeligsoft, 2008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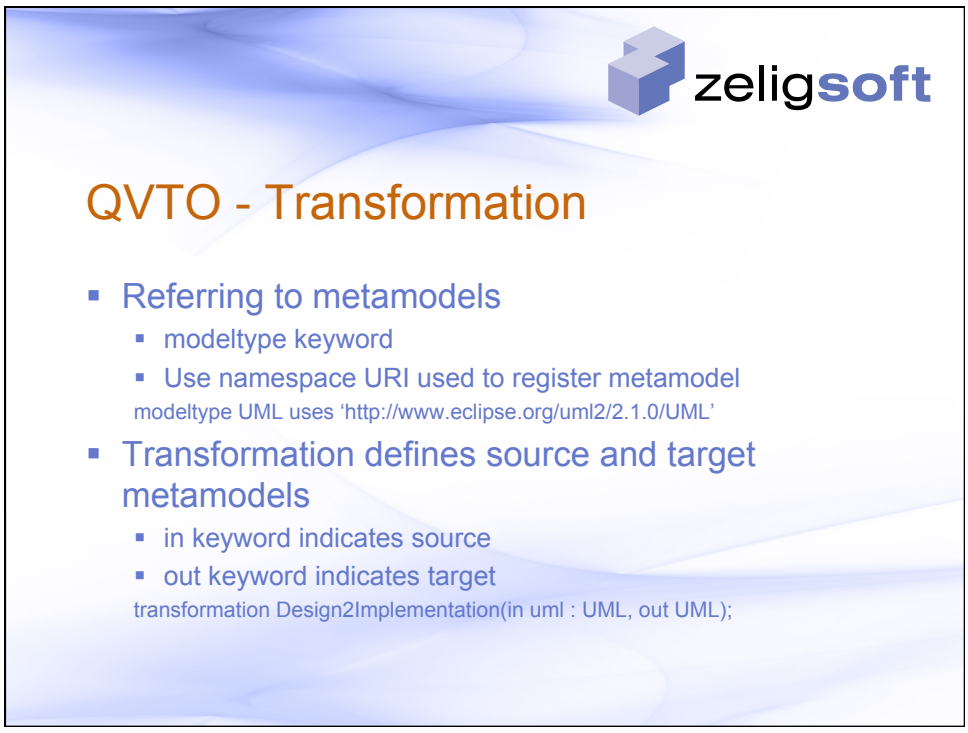
Integrating with the Workbench
Add an action to the workbench
Create a context
Use an interpreted QVT transformation
Grab the input model element from a Resource or editor
Execute the transformation
Display or persist results and trace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QVTO - Transformation
Referring to metamodels
modeltype keyword
Use namespace URI used to register metamodel
modeltype UML uses 'http://www.eclipse.org/uml2/2.1.0/UML'
Transformation defines source and target metamodels
in keyword indicates source
out keyword indicates target
transformation Design2Implementation(in uml : UML, out UML);

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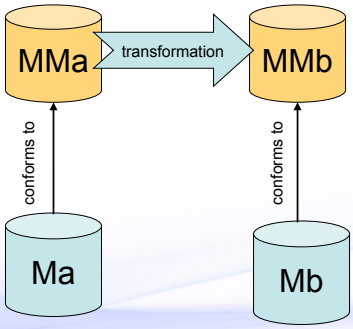
QVTO - Transformation

- Source model Ma that conforms to metamodel MMa
- Target model Mb that conforms to metamodel MMb
- Possible to have multiple sources and targets



transformation mMa2MMb(in ma : Mma, out mb : MMb);

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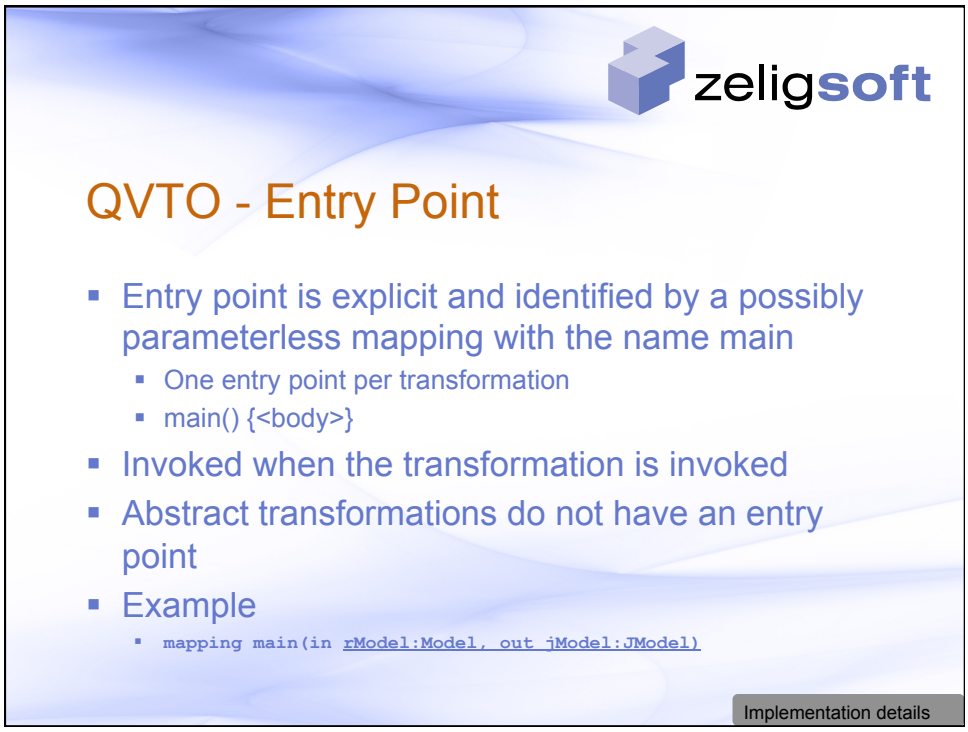
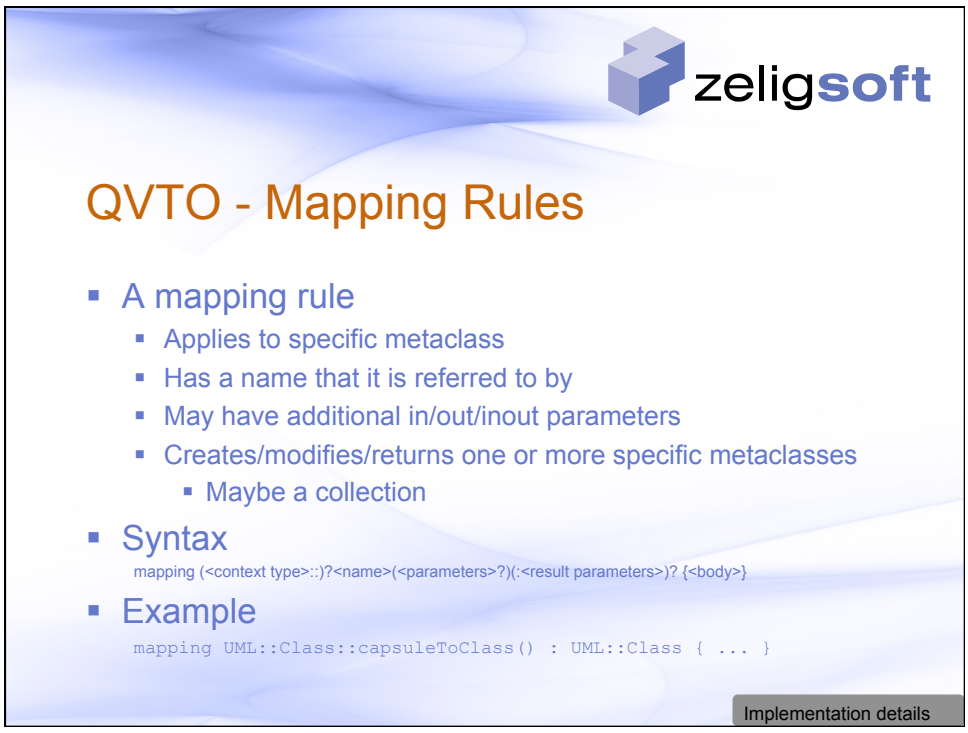
QVTO - Metamodels

- Define the parameter types for transformations
- Can be explictly referenced by their namespace URI
  - UML - http://www.eclipse.org/uml2/2.1.0/UML
  - Ecore - http://www.eclipse.org/emf/2002/Ecore
- Use Metamodel Explorer view to find URI's
  - Window → Show View → Metamodel Explorer
- Syntax

  modeltype <local name> **uses** '<ns uri>';

  modeltype UML **uses** 'http://www.eclipse.org/uml2/2.1.0/UML';





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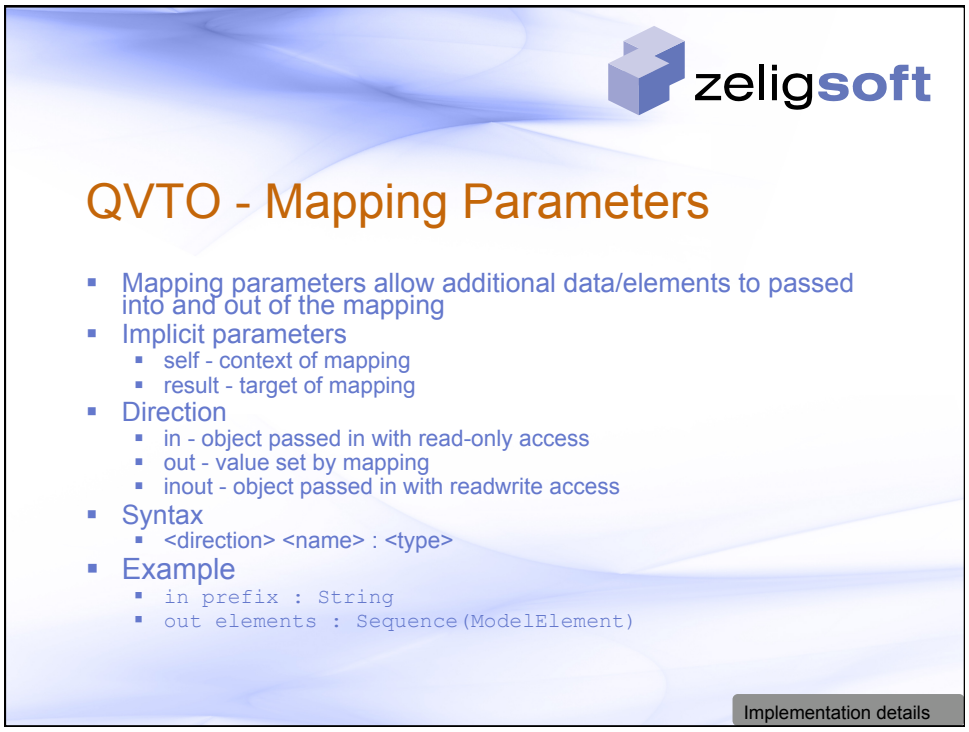
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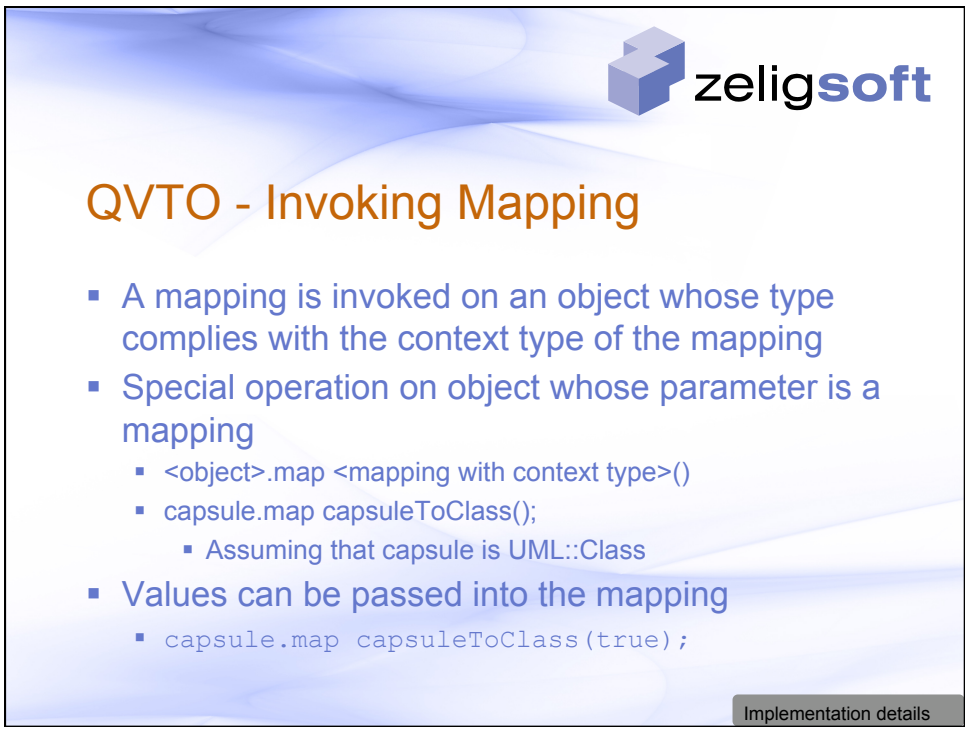
QVTO - Mapping Parameters
Mapping parameters allow additional data/elements to passed into and out of the mapping
Implicit parameters
self - context of mapping
result - target of mapping
Direction
in - object passed in with read-only access
out - value set by mapping
inout - object passed in with readwrite access
Syntax
<direction> <name> : <type>
Example
in prefix : String
out elements : Sequence(ModelElement)
Implementation details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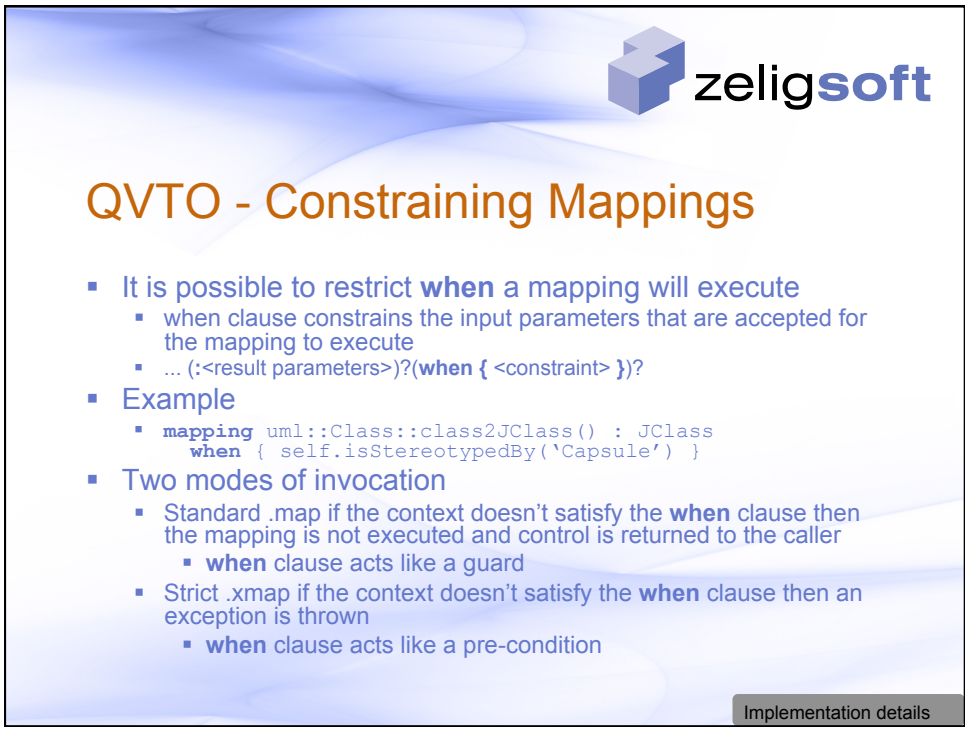
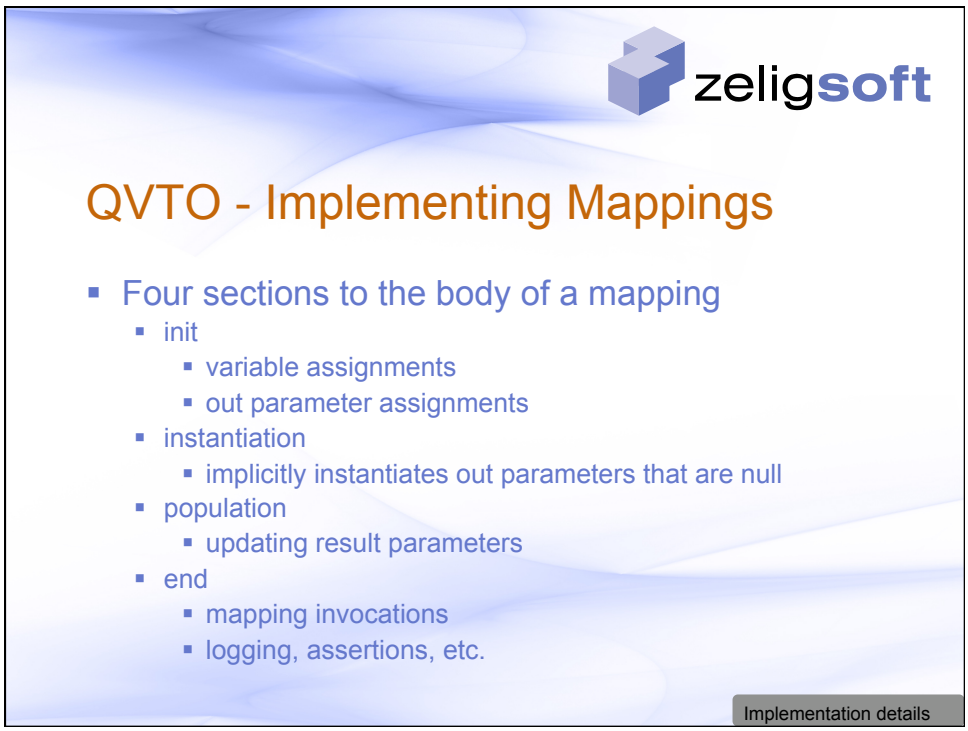
QVTO - Invoking Mapping
A mapping is invoked on an object whose type complies with the context type of the mapping
Special operation on object whose parameter is a mapping
<object>.map <mapping with context type>()
capsule.map capsuleToClass();
Assuming that capsule is UML::Class
Values can be passed into the mapping
capsule.map capsuleToClass(true);
Implementation details





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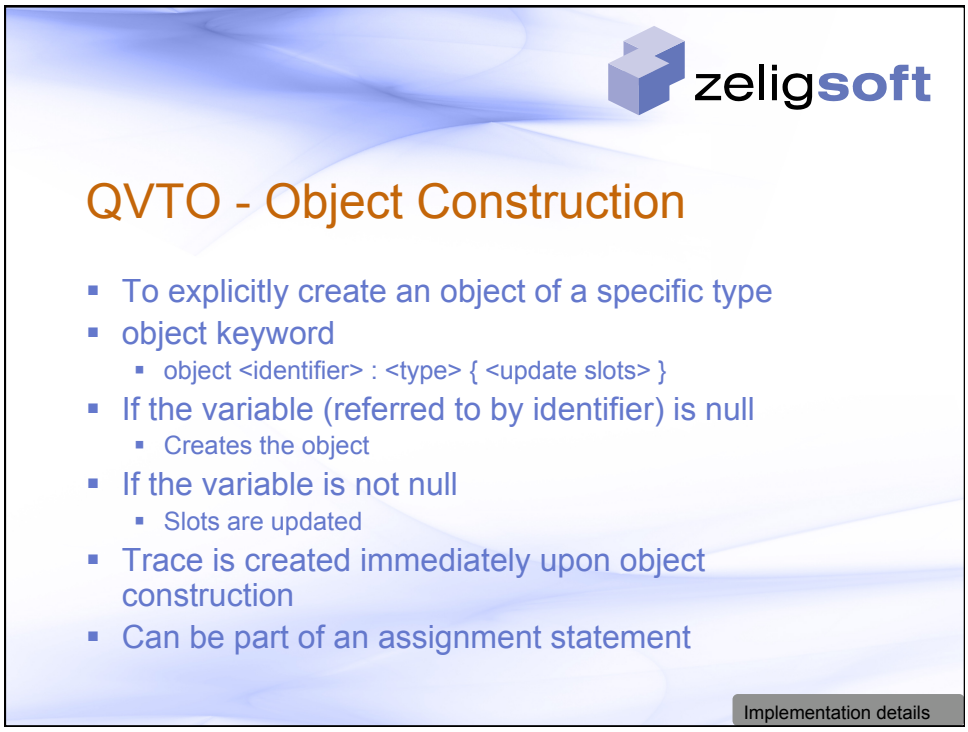

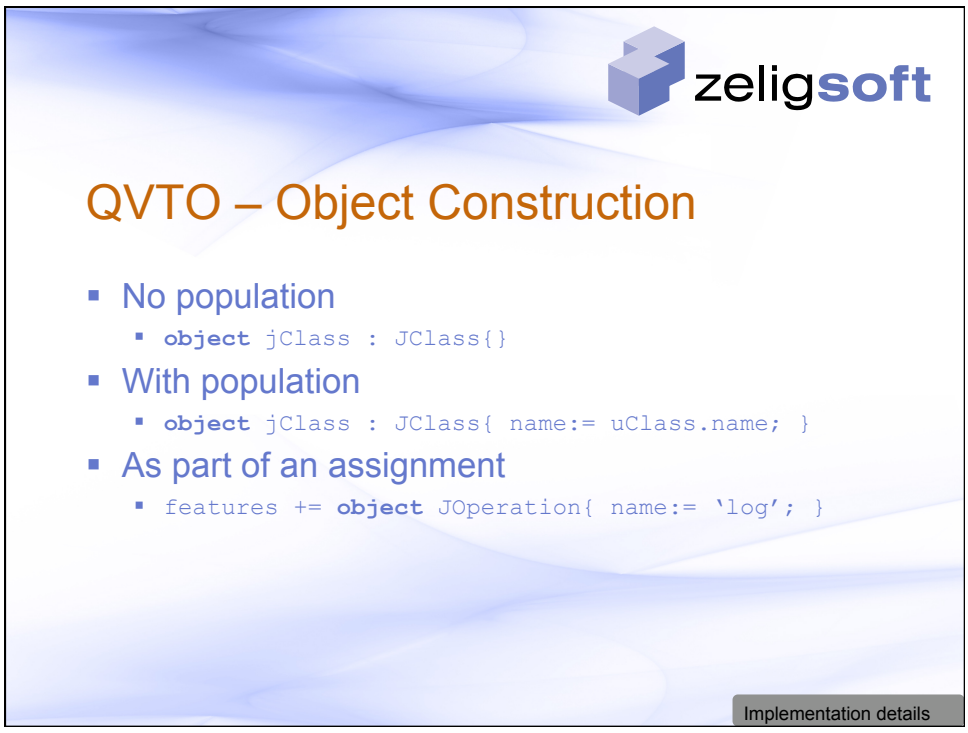

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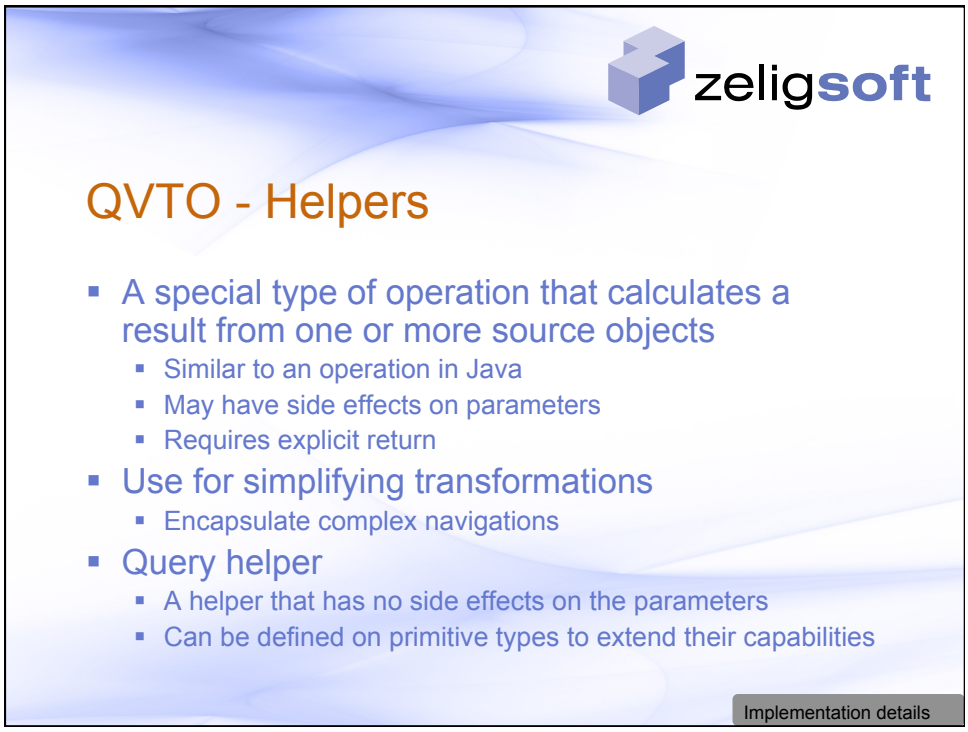

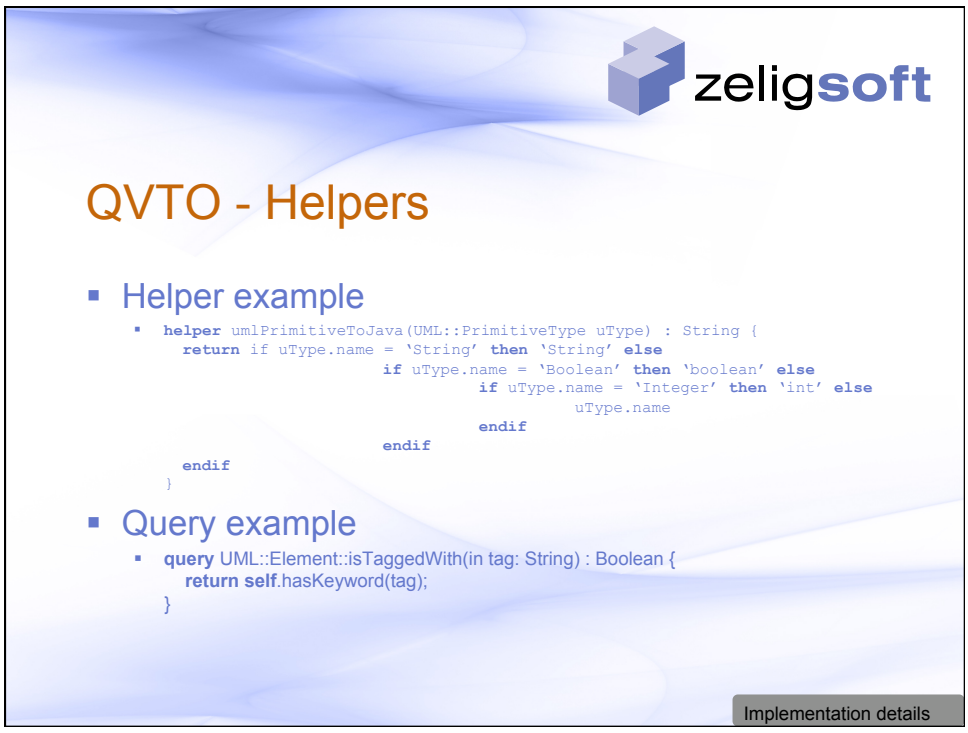

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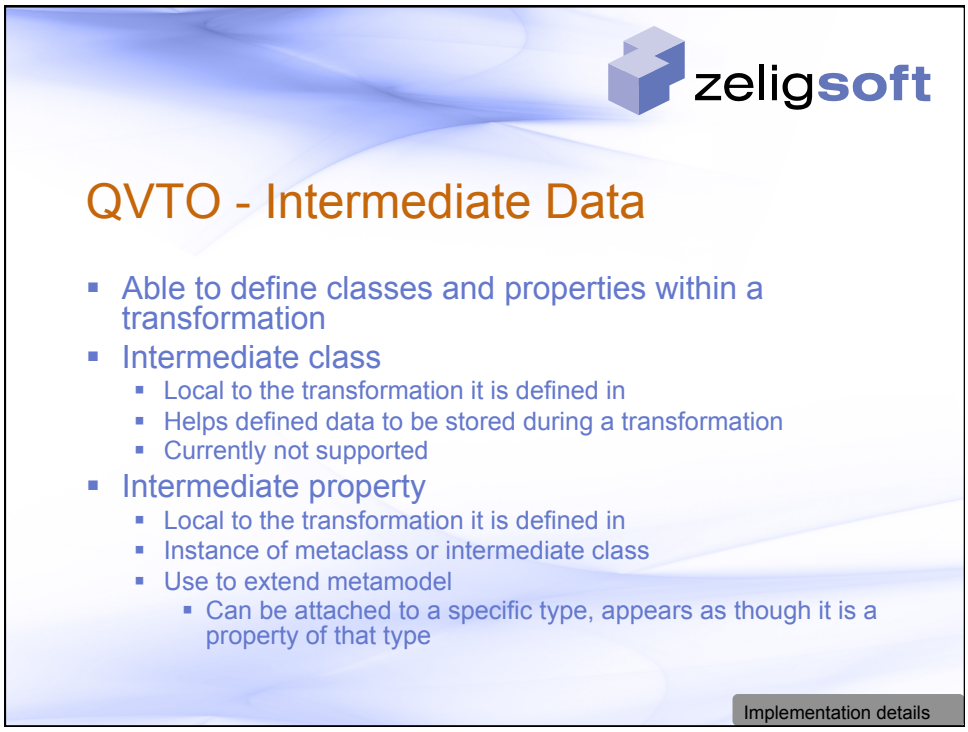

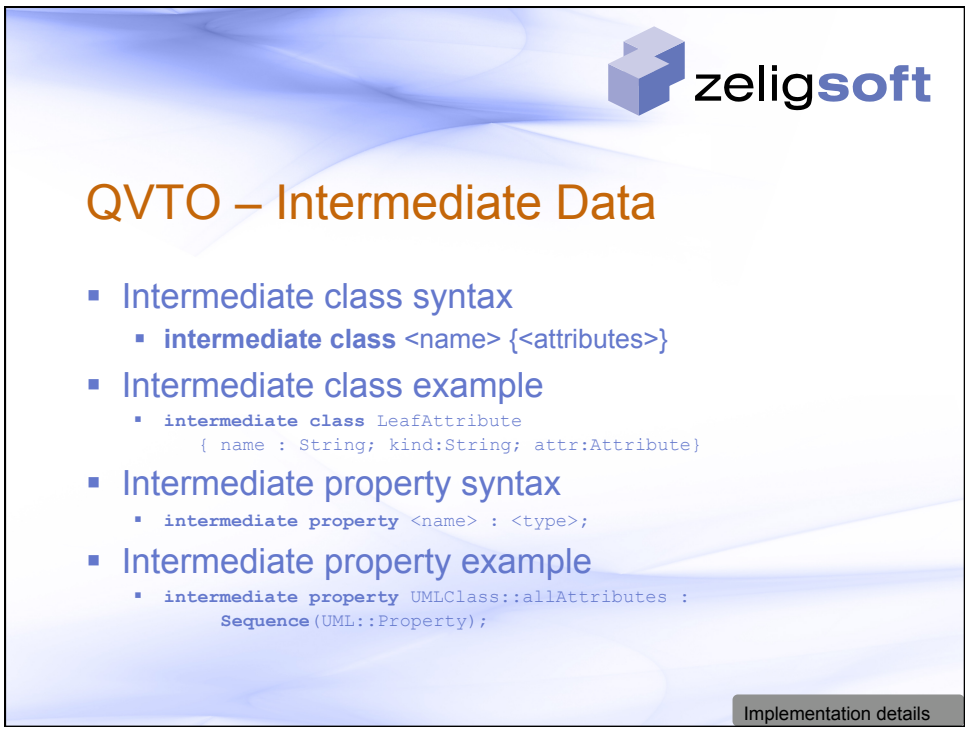

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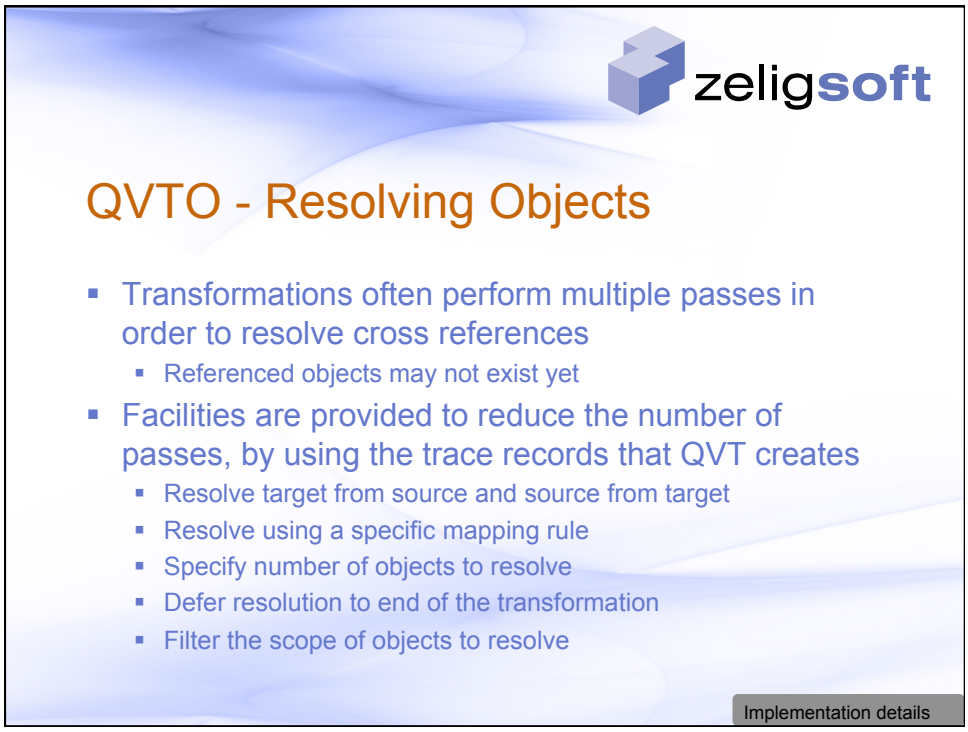

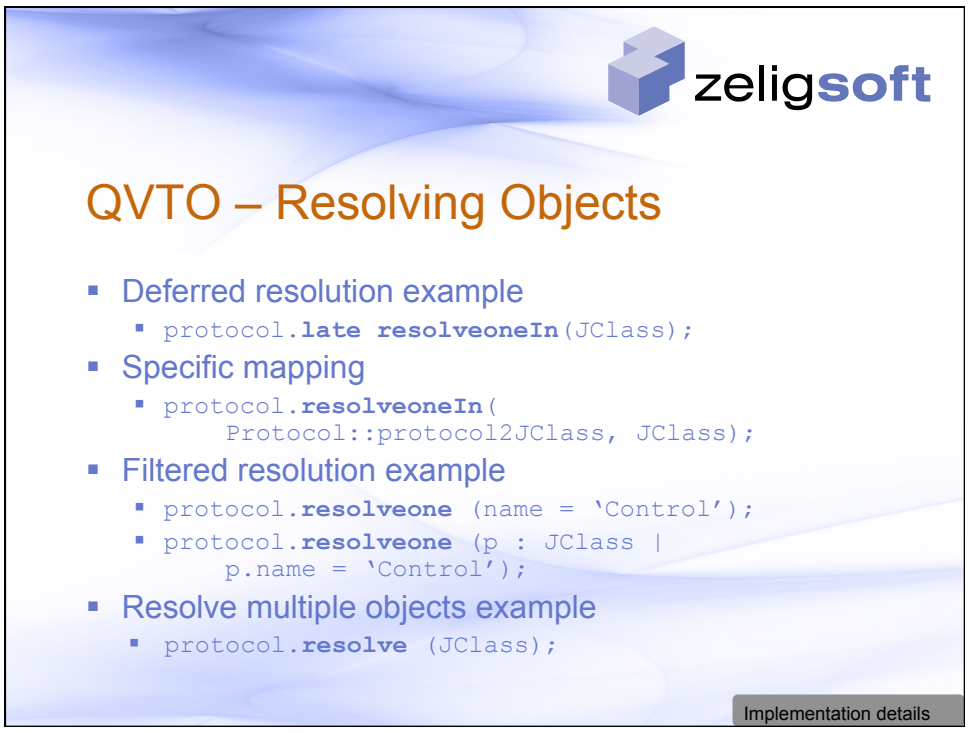

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QVTO – Transformation reuse

- Composition
  - Explicit instantiation and invocation
  - **transformation** ROOM2JavaExt(in room : ROOM, out java : JAVA)
    access transformation ROOM2Java(in ROOM, out JAVA)

```
main() {
  var base :=  new ROOM2Java(room, java);
  base.transform();
}
```

- Extension
  - Implicit instantiation
  - Ability to override a mapping in the extended transformation, which will be used in place of the mapping int he extended transformation
  - **transformation** ROOM2JavaExt(in room : ROOM, out java : JAVA)
    extends transformation ROOM2Java(in ROOM, out JAVA)

Implementation details

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QVTO – Mapping Reuse

- Inheritance
  - Inherited mapping is executed after the init section
  - mapping A::AtoSubB() : SubTypeofB inherits A::AtoB {…}
    - Executes init of AtoSubB then AtoB then the rest of AtoSubB
- Merge
  - List of mappings executed in sequence after end section
  - mapping A::AtoB() : B
    merges A::toSuperB1, A::toSuperB2 {}
    - Executes AtoB then toSuperB1, then toSuperB2
- Parameters of inherited/merged mappings must match

Implementation details

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QVTO - Disjuncts

- An ordered list of mappings
  - First mapping in the list whose guard (type and when clause) is satisfied is executed
  - Null is returned if no mapping in the list is executed
- Example

```
mapping PackageableElement::roomElement2JCompilationUnit()
: JCompilationUnit
   disjuncts Actor::actor2JCompilationUnit,
             Protocol::protocol2JCompilationUnit {
}
```

Implementation details

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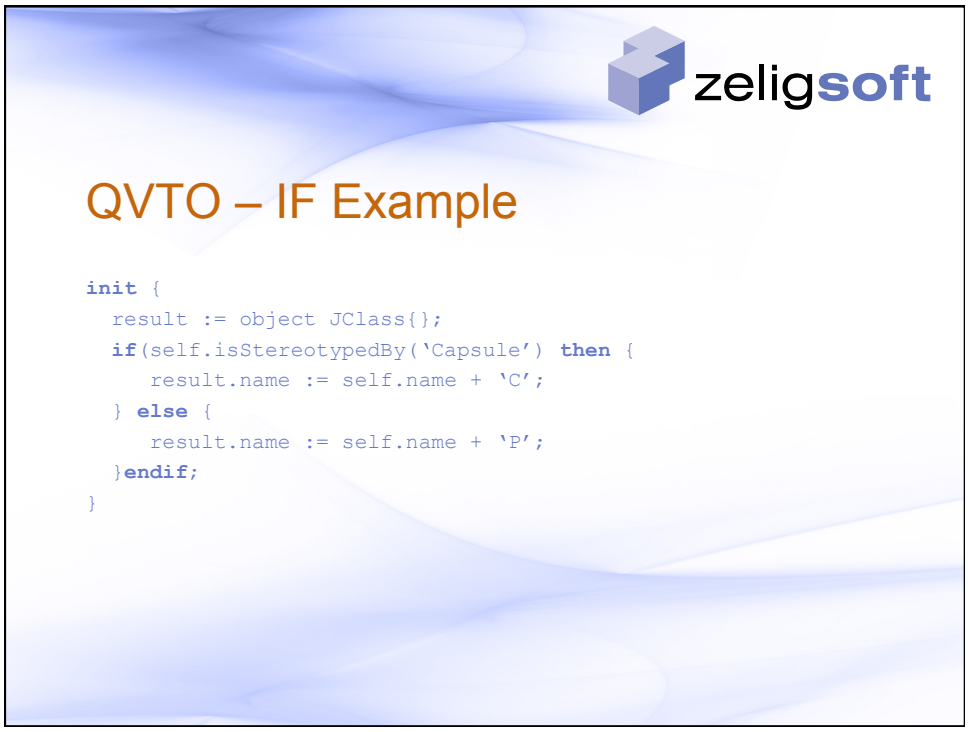
QVTO - Control

- while loop
  - execute a block until a condition is false
- foreach
  - iterate over a block
  - can add filter to the iterator
- while and foreach support
  - break
  - continue
- if-then-else
  - if(<cond>){<block>}
    elif(<cond>){<block>}
    else{<block>}

Implementation details



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QVTO - More than 1 Target Model
When multiple target models are specified, need to be able to indicate which one a model is instantiated in
object <type>@<target model>{}
mapping <type>::<name> : <type>@<target model> {}
Implementation details


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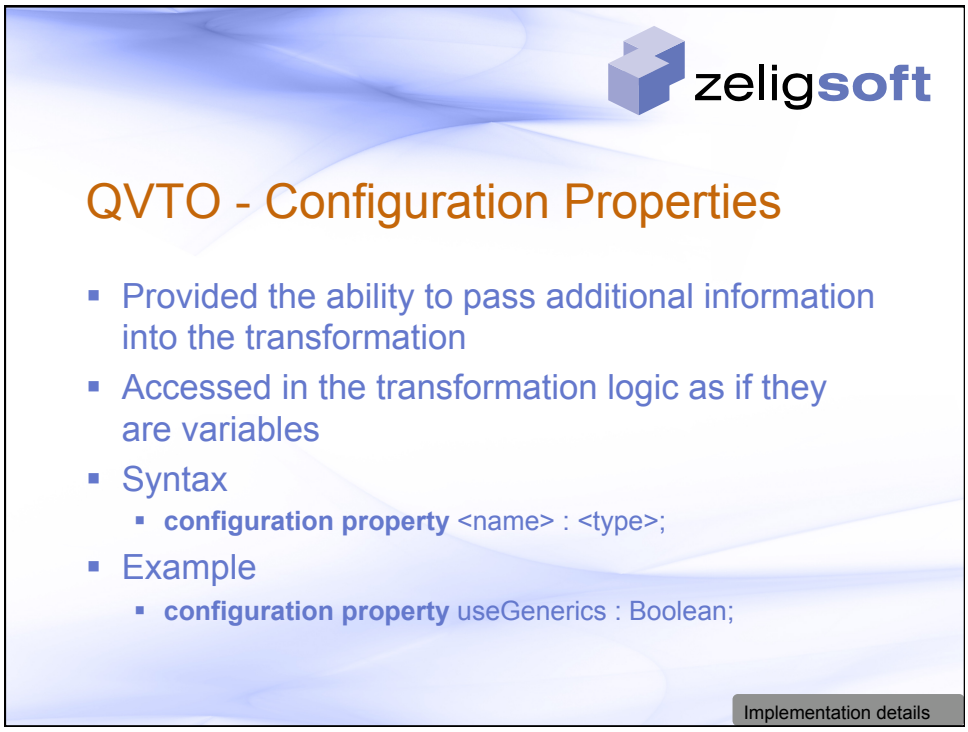
QVTO - Libraries
A QVTO library
contains definitions of specific types
contains queries, constructors, and mappings
A library must explicitly included
By extending
By accessing
Blackboxing
Defining a library in a language other than QVT
Implementation details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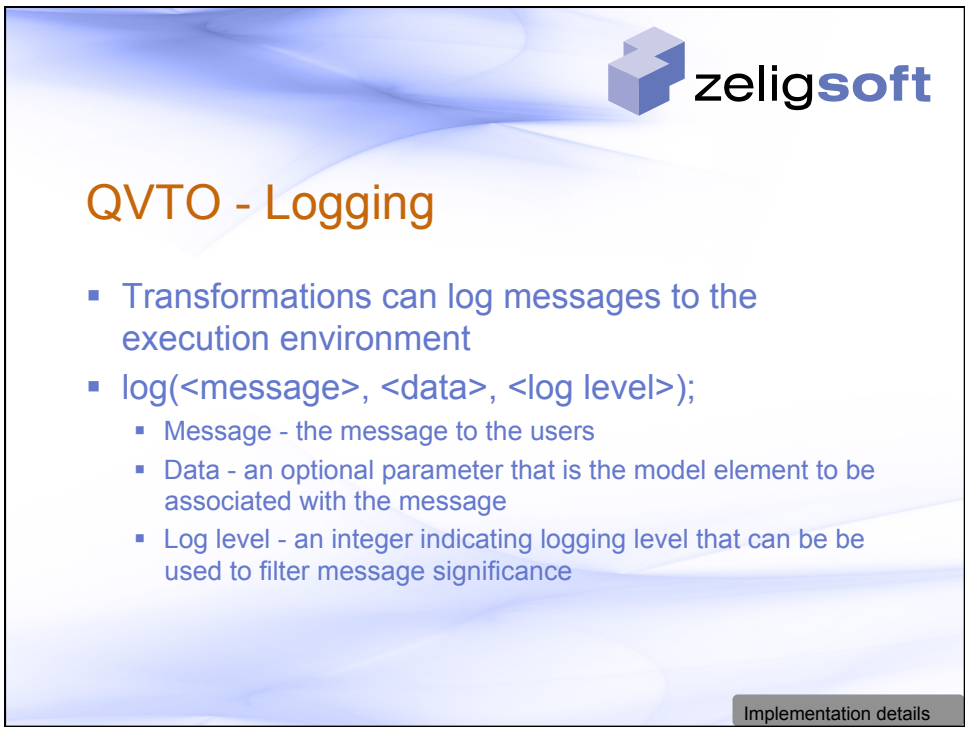
QVTO - Configuration Properties
Provided the ability to pass additional information into the transformation
Accessed in the transformation logic as if they are variables
Syntax
configuration property <name> : <type>;
Example
configuration property useGenerics : Boolean;
Implementation details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QVTO - Logging
Transformations can log messages to the execution environment
log(<message>, <data>, <log level>);
Message - the message to the users
Data - an optional parameter that is the model element to be associated with the message
Log level - an integer indicating logging level that can be be used to filter message significance
Implementation details

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QVTO - Working with Profiles

- QVTO provides no special operators for working with UML2 profiles
- Transformations and mappings use the API defined in the UML2 metamodel
- A library can be built to simplify the UML2 stereotype API
- Example
  - query UML::Element::isStereotypedBy(in qualifiedName : String) : Boolean {
    return self.getAppliedStereotype(qualifiedName) <> null;
    }

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QVTO - Extensions

- Blackbox libraries are defined through the org.eclipse.m2m.qvt.oml.ocl.libraries extension point
- Must have a static class Metainfo
  - specifies the parameters of the transformation
- Enables QVTO to leverage the power of a 3GL like Java

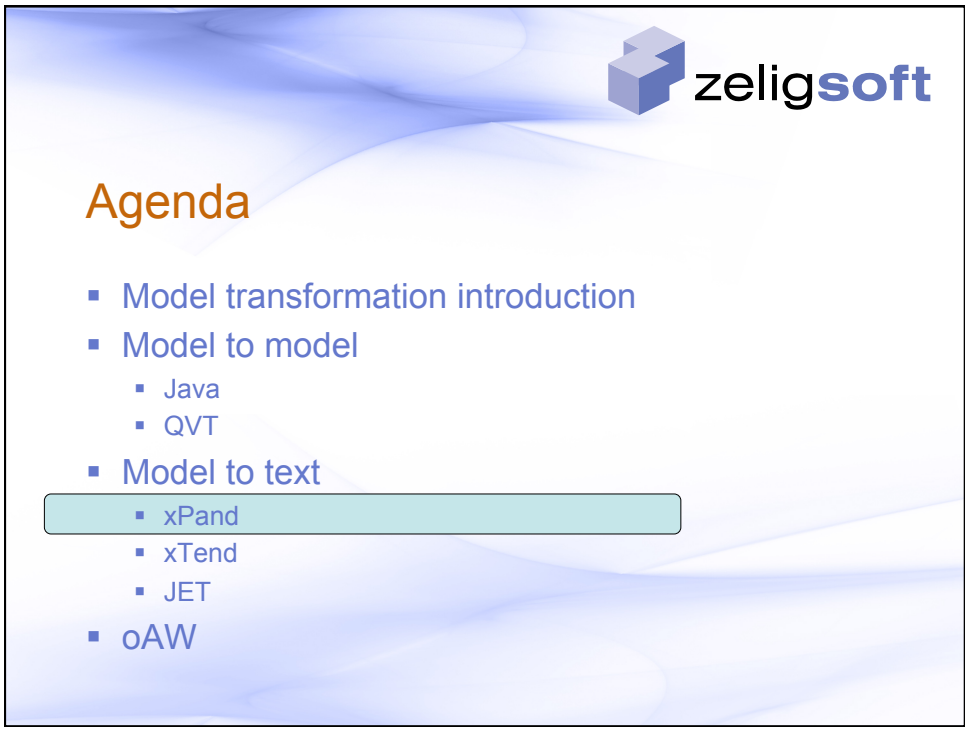
QVTO - Programatically Invoking

```
URI transformation =
  URI.createURI("platform:/resource/com.eett.exercises.m2m.qvt/transforms/
Room2Java.qvto");
IFile qvtFile = getIFile(transformation);
IContext qvtContext = new Context();
QvtInterpretedTransformation trans =
   new QvtInterpretedTransformation(qvtFile);
EObject inputModel =
   getInput(
     URI.createURI("platform:/resource/com.eett.exercises.m2m.qvt/testModels/
packageableElementTest.room"));
EObject[] inputs = {inputModel};
TransformationRunner.In input =
   new TransformationRunner.In(inputs, qvtContext);
TransformationRunner.Out output = null;

try {
   output = trans.run(input);
} catch (MdaException e) {
   out.println("Error running transformation!");
   out.println(e.getMessage());
}
```

Summary

- In this module we explored
  - QVT mappings
  - Invoking QVT
  - Details on QVT usage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Agenda
Model transformation introduction
Model to model
Java
QVT
Model to text
xPand
xTend
JET
oAW


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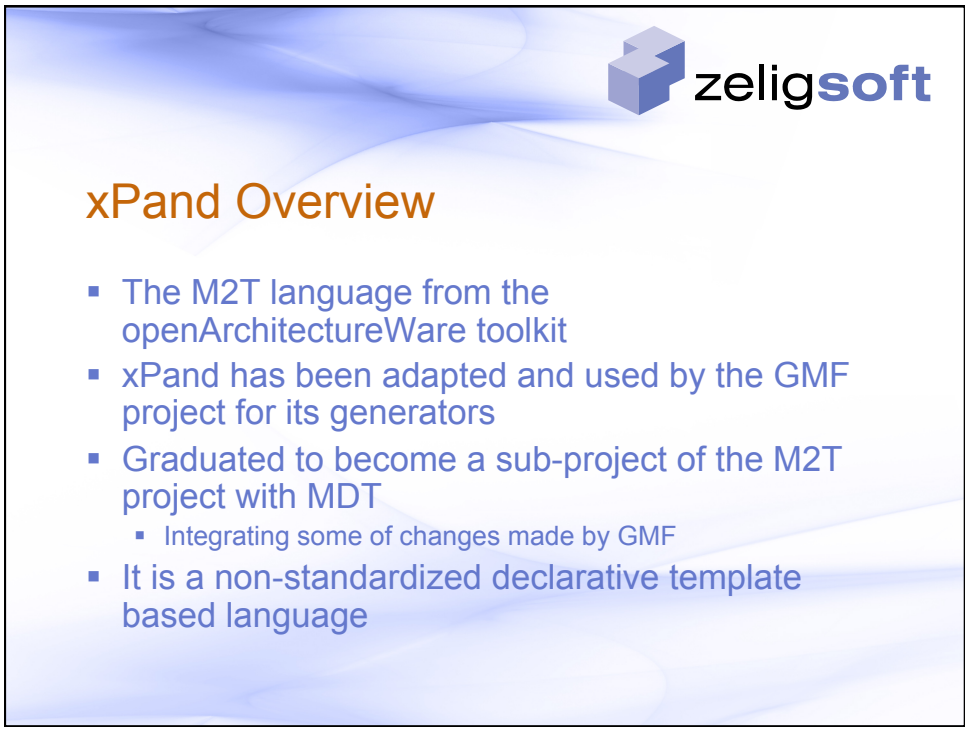
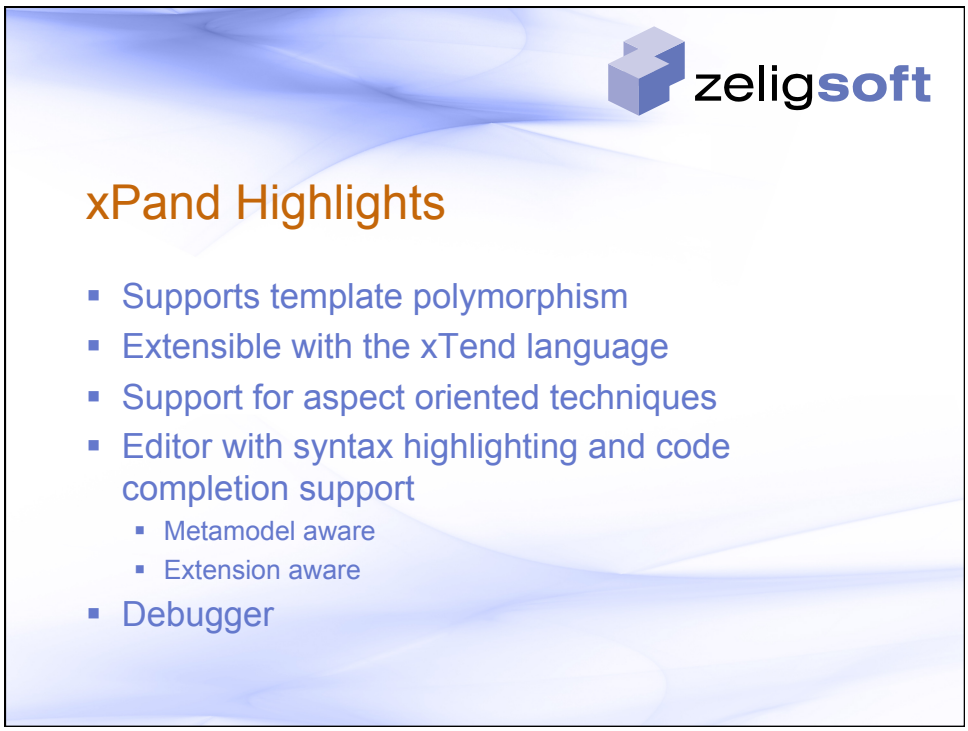
Eclipse Transformation Technologies
M2T with xPand





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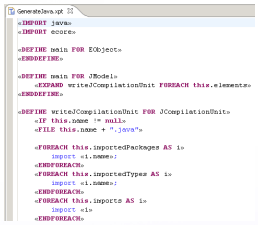
Developing xPand Transformations



- Editor
  - Syntax highlighting
  - Code completion
- Model navigation
  - Java based syntax for model navigation
  - Has operators for working with collections
- Focus on transformation logic
  - Execution infrastructure left to the xPand runtime

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Executing an xPand Transformation

- Using an oAW workflow
  - More about workflows later
  - Can use integration with the Run as... or Debug as... oAW workflow
- Write a Java application
  - Call the transformation explicitly in code
    - Use the XPandFacade class
  - Use the Run as... or Debug as... Java Application

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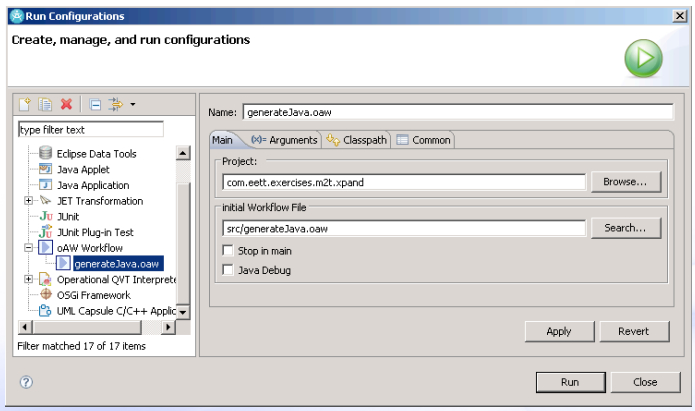
Executing an xPand Transformation



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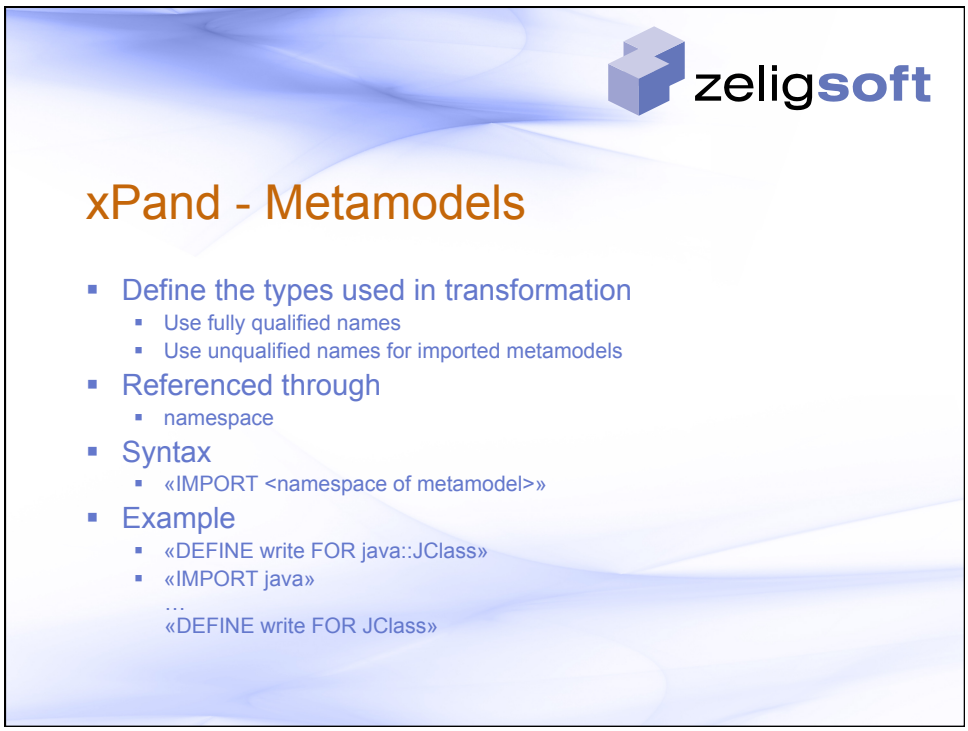
Integrating with Workbench

- Contribute an action to the editor's menu
  - Implement the action handler
    - Call the workflow passing in the selected element as the source
- Alternative is append to an existing action
  - e.g. the ROOM to Java transformation
- Test
  - In runtime workbench
- Deploy
  - Publish the plug-in



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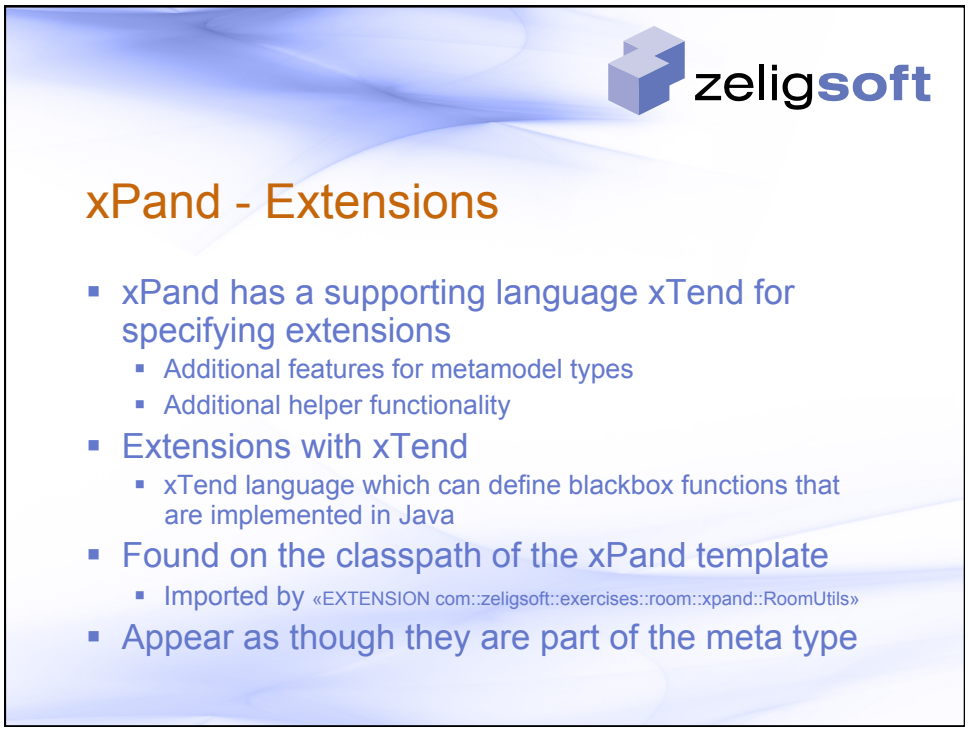
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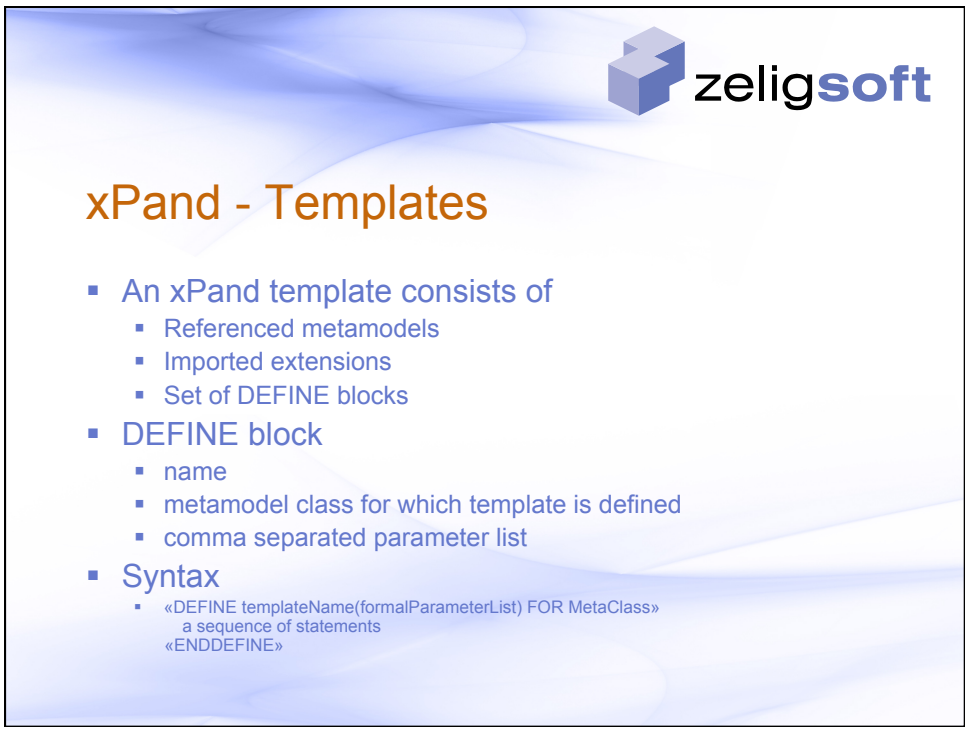
xPand - Extensions
xPand has a supporting language xTend for specifying extensions
Additional features for metamodel types
Additional helper functionality
Extensions with xTend
xTend language which can define blackbox functions that are implemented in Java
Found on the classpath of the xPand template
Imported by «EXTENSION com::zeligsoft::exercises::room::xpand::RoomUtils»
Appear as though they are part of the meta type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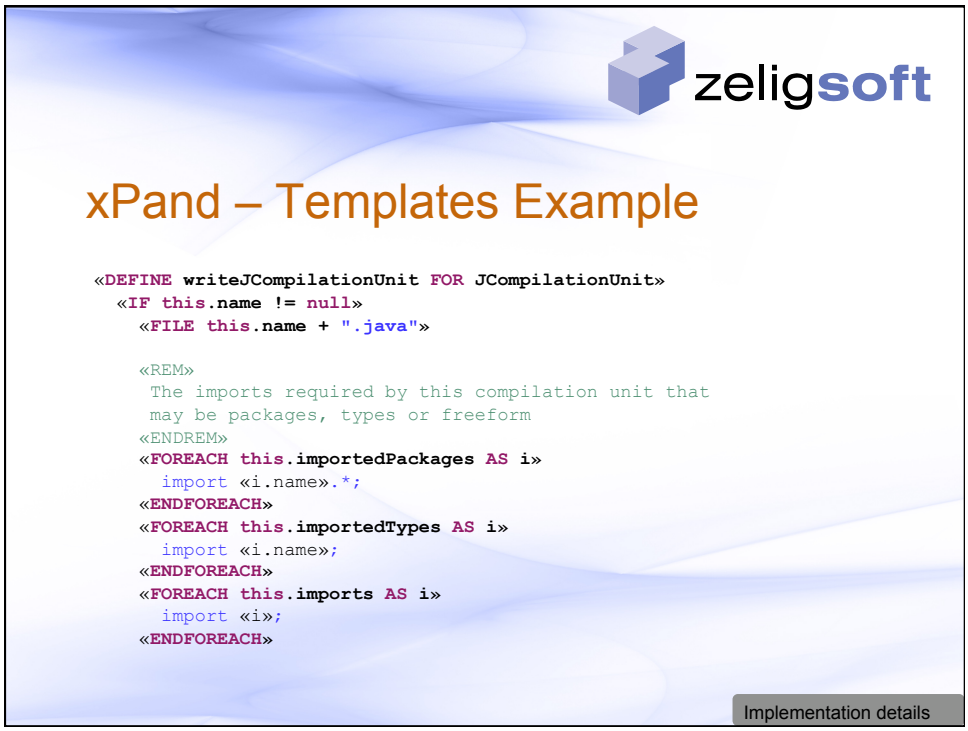
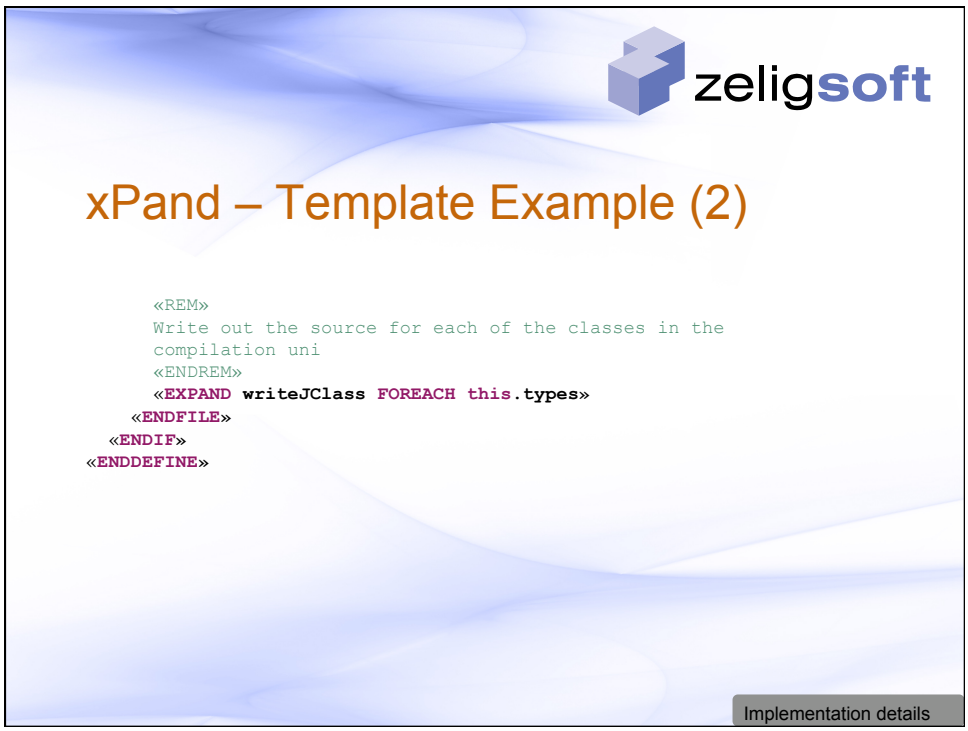
xPand - Templates
An xPand template consists of
Referenced metamodels
Imported extensions
Set of DEFINE blocks
DEFINE block
name
metamodel class for which template is defined
comma separated parameter list
Syntax
«DEFINE templateName(formalParameterList) FOR MetaClass»
a sequence of statements
«ENDDEFINE»





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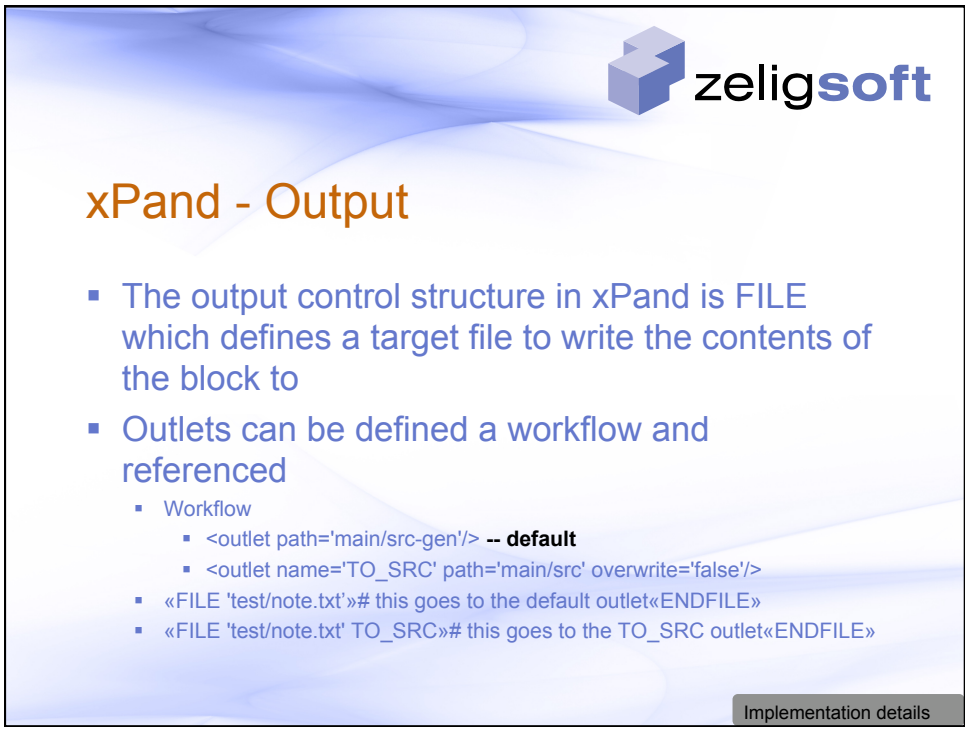
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xPand - Output
The output control structure in xPand is FILE which defines a target file to write the contents of the block to
Outlets can be defined a workflow and referenced
Workflow
<outlet path='main/src-gen'/> -- default
<outlet name='TO_SRC' path='main/src' overwrite='false'/>
«FILE 'test/note.txt'»# this goes to the default outlet«ENDFILE»
«FILE 'test/note.txt' TO_SRC»# this goes to the TO_SRC outlet«ENDFILE»
Implementation details


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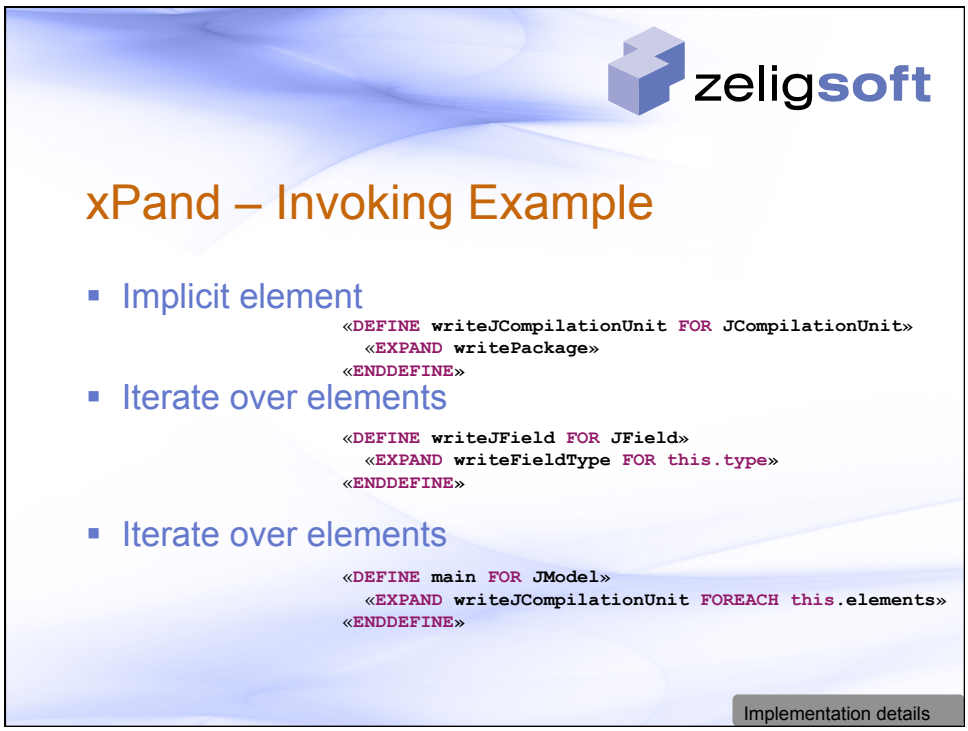
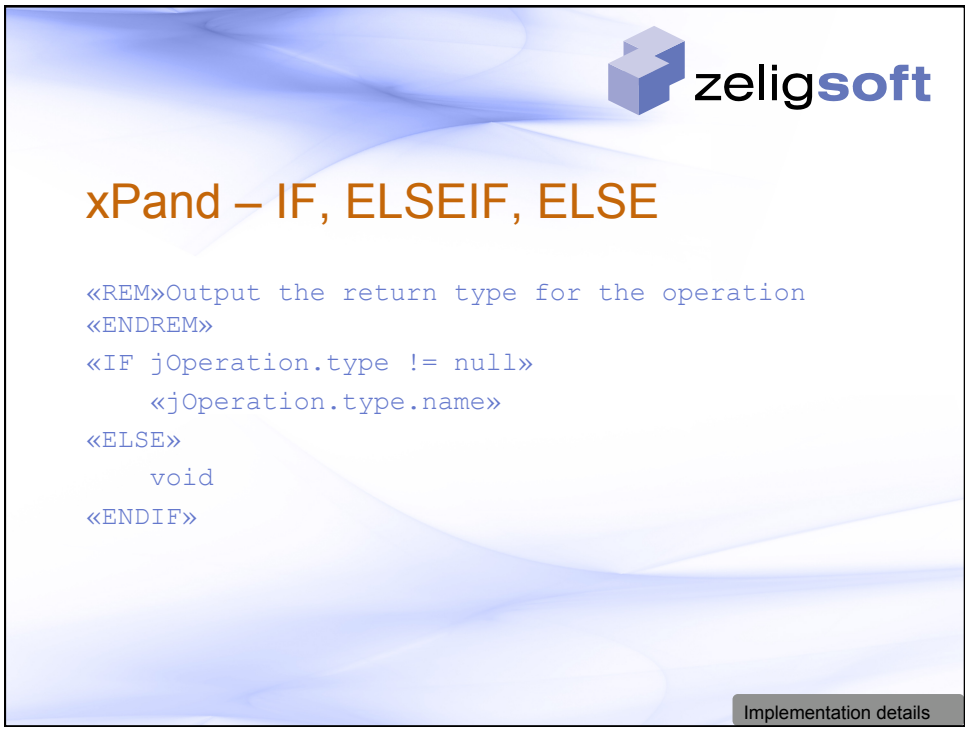
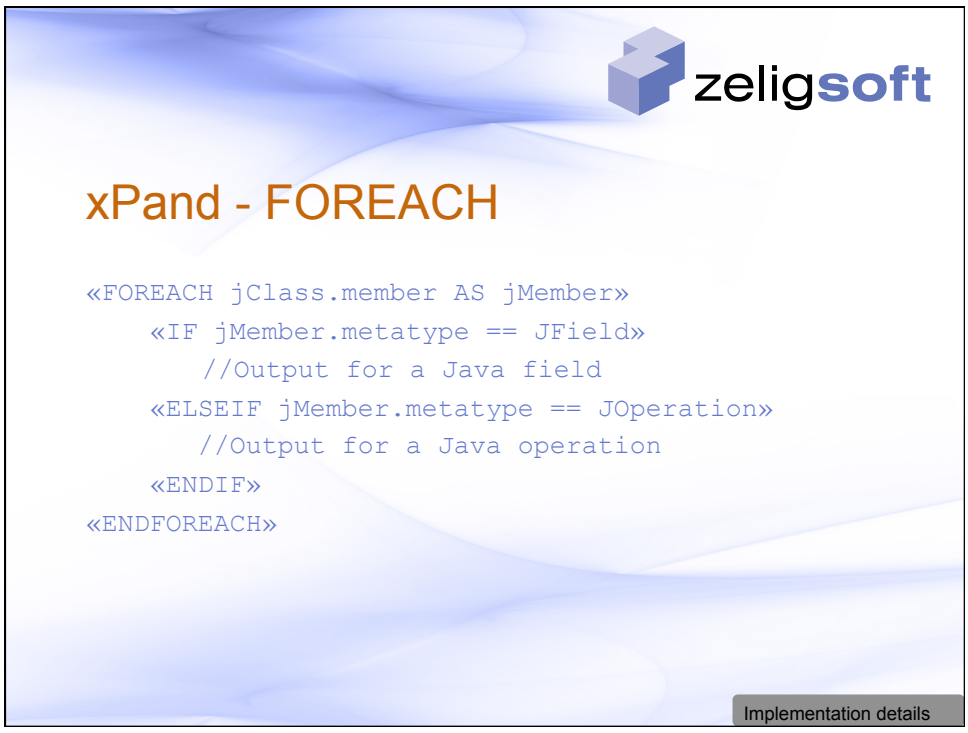
xPand - Invoking a Template
The xPand language uses EXPAND to invoke a template
«EXPAND definitionName [(parameterList)]
[FOR expression | FOREACH expression [SEPARATOR expression]]»
FOR
Invokes the template on the specified element
FOREACH
Invokes the template on each element in the collection
SEPERATOR
Specifies an optional delimiter output between each invocation
Omitting FOR\FOREACH invokes with FOR this
Implementation details



Toby McClean, Zeligsoft, 2008

Toby McClean, Zeligsoft, 2008





Toby McClean, Zeligsoft, 2008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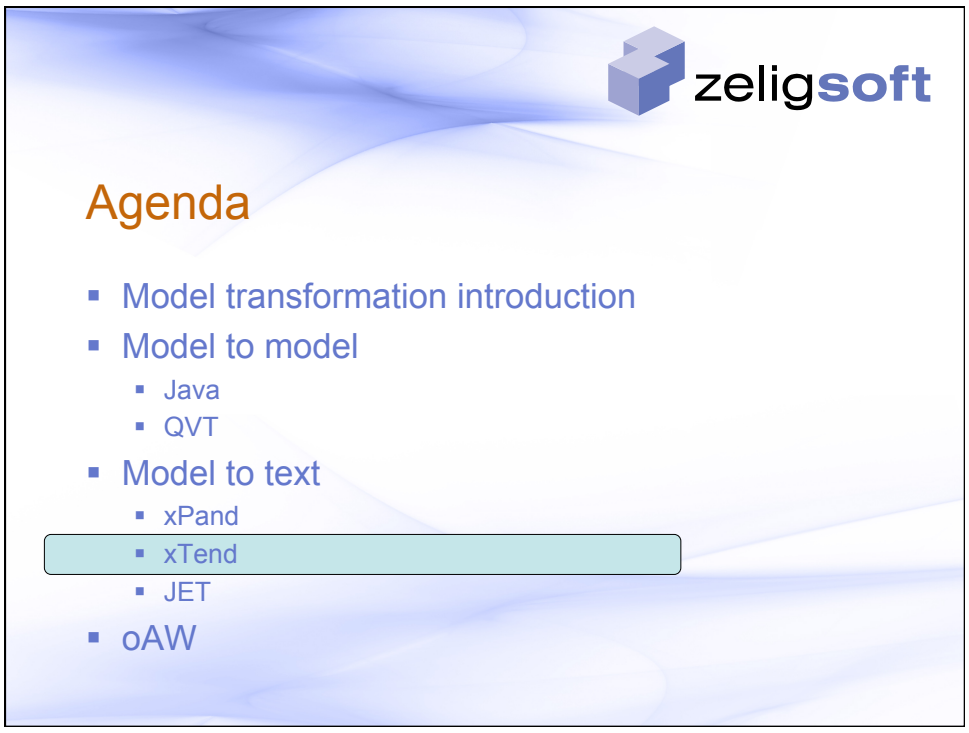
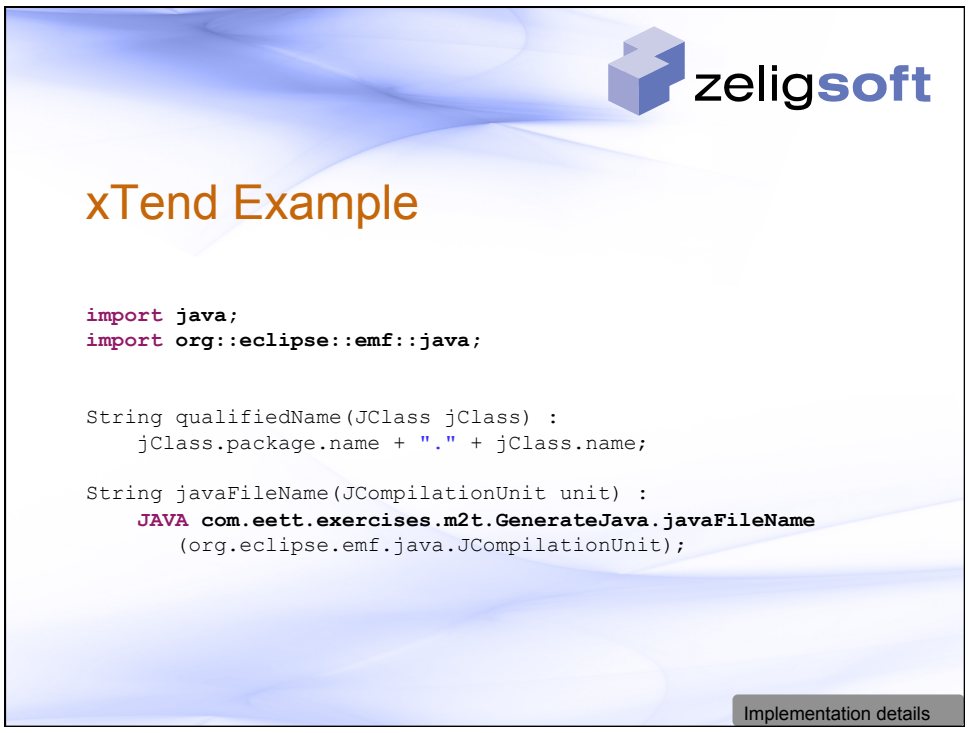
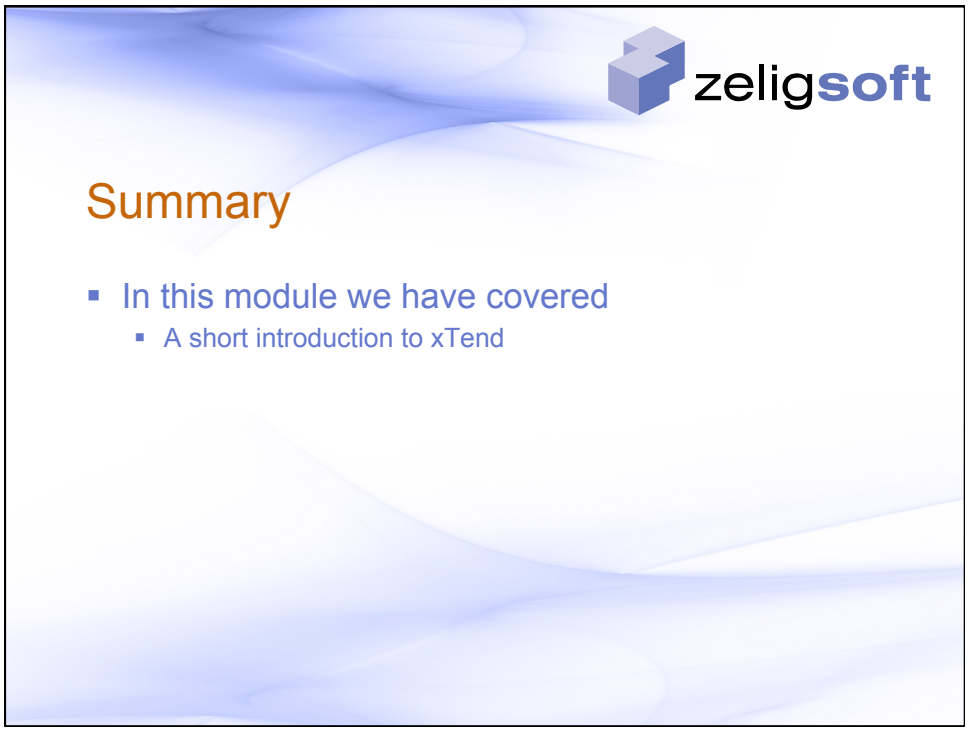
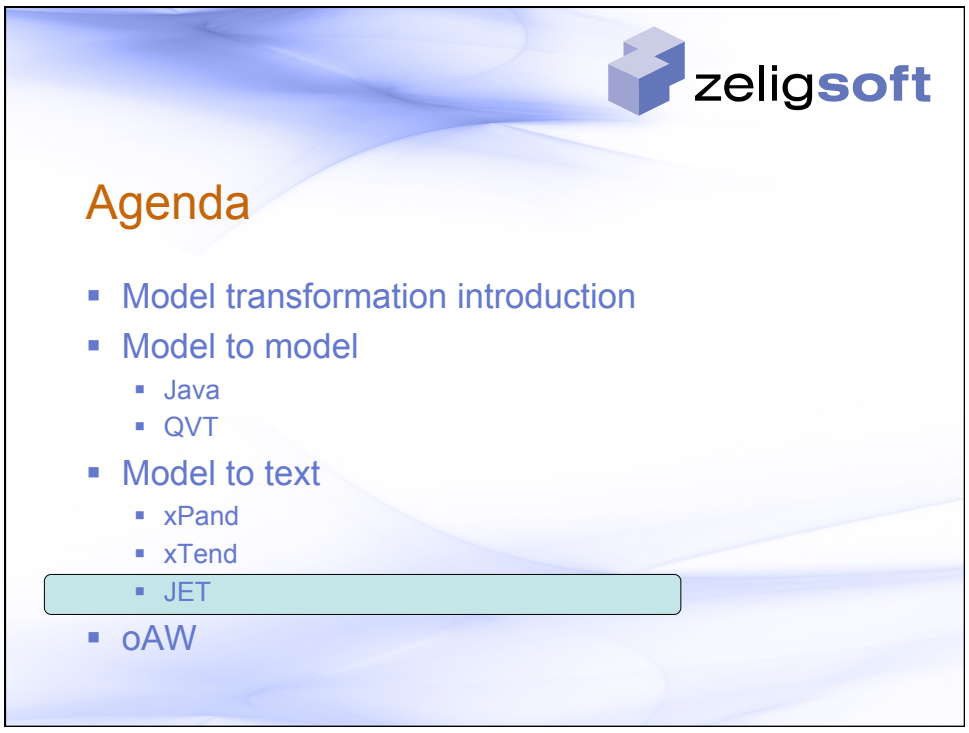
Summary
In this module we explored
xPand transformations
Invoking xPand
xPandsyntax


zeligsoft
Agenda
Model transformation introduction
Model to model
Java
QVT
Model to text
xPand
xTend
JET
oAW



Toby McClean, Zeligsoft, 2008


zeligsoft
Summary
In this module we have covered
A short introduction to xTend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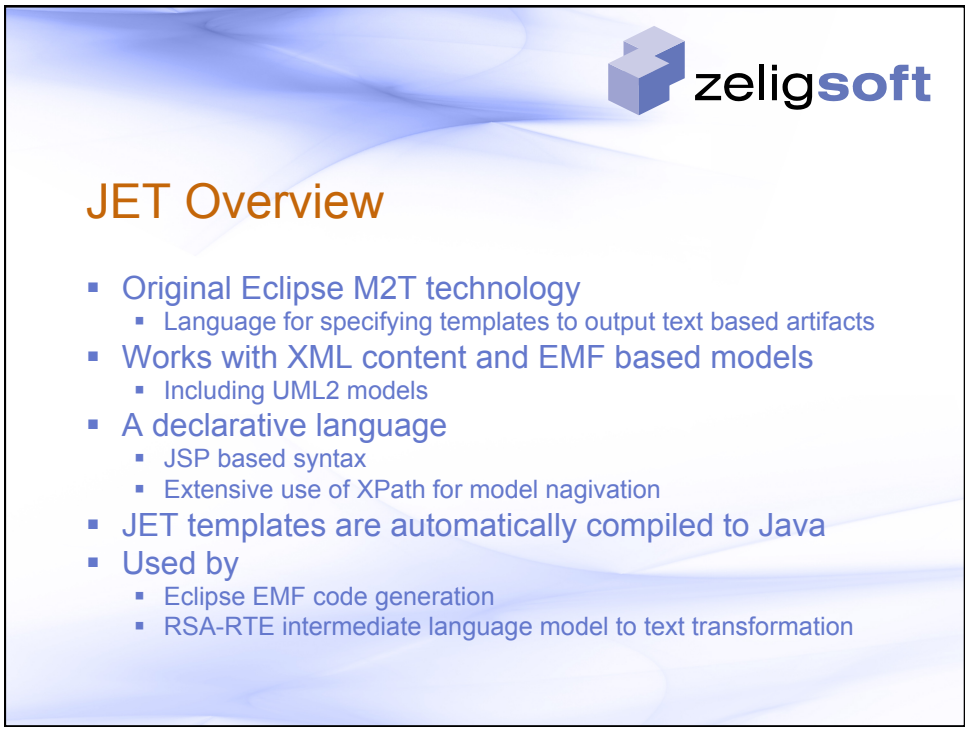
Agenda
Model transformation introduction
Model to model
Java
QVT
Model to text
xPand
xTend
JET
oAW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JET Overview
Original Eclipse M2T technology
Language for specifying templates to output text based artifacts
Works with XML content and EMF based models
Including UML2 models
A declarative language
JSP based syntax
Extensive use of XPath for model nagivation
JET templates are automatically compiled to Java
Used by
Eclipse EMF code generation
RSA-RTE intermediate language model to text transformation


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Developing a JET Transformation
JET transformations can be created by
Adding a JET transformation to an existing project
Creating a JET transformation project
Editor
Syntax highlighting
Model navigation
XPath
Focus on transformation logic
Execution infrastructure left to the compiled JET code

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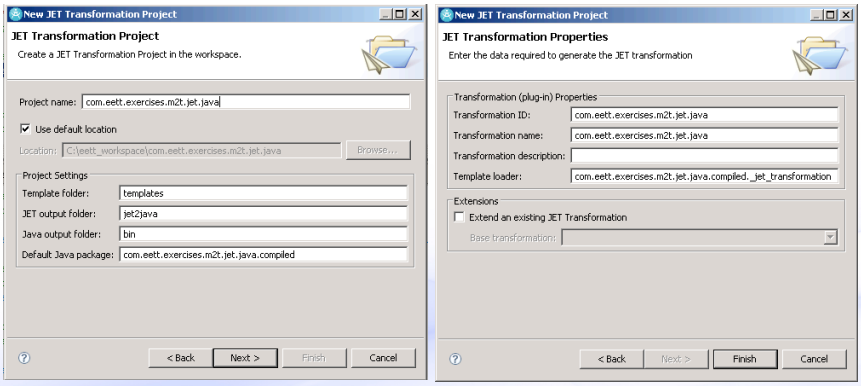
Developing a JET Transformation



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Executing a JET Transformation

- The JET project integrates with the workbench Run framework
- Select the transformation resource in the project explorer
- Choose Run As → Run Configurations… from the context menu
- Create a new configuration under JET transformation
  - The input model is specified
  - The option to save the configuration for sharing

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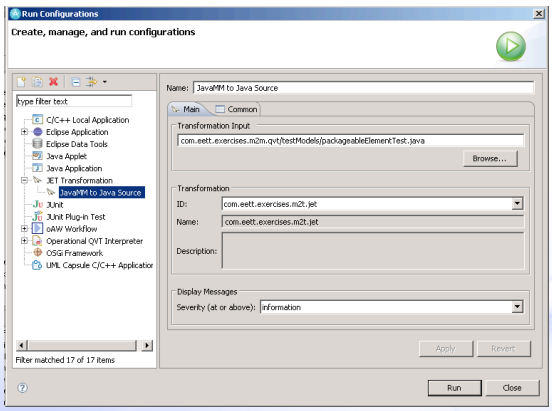
Executing a JET Transformation



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Integrating with Workbench

- Contribute an action to the editor's menu
  - Implement the action handler
    - Call the workflow passing in the selected element as the source
- Alternative is append to an existing action
  - e.g. the ROOM to Java transformation
- Test
  - In runtime workbench
- Deploy
  - Publish the plug-in


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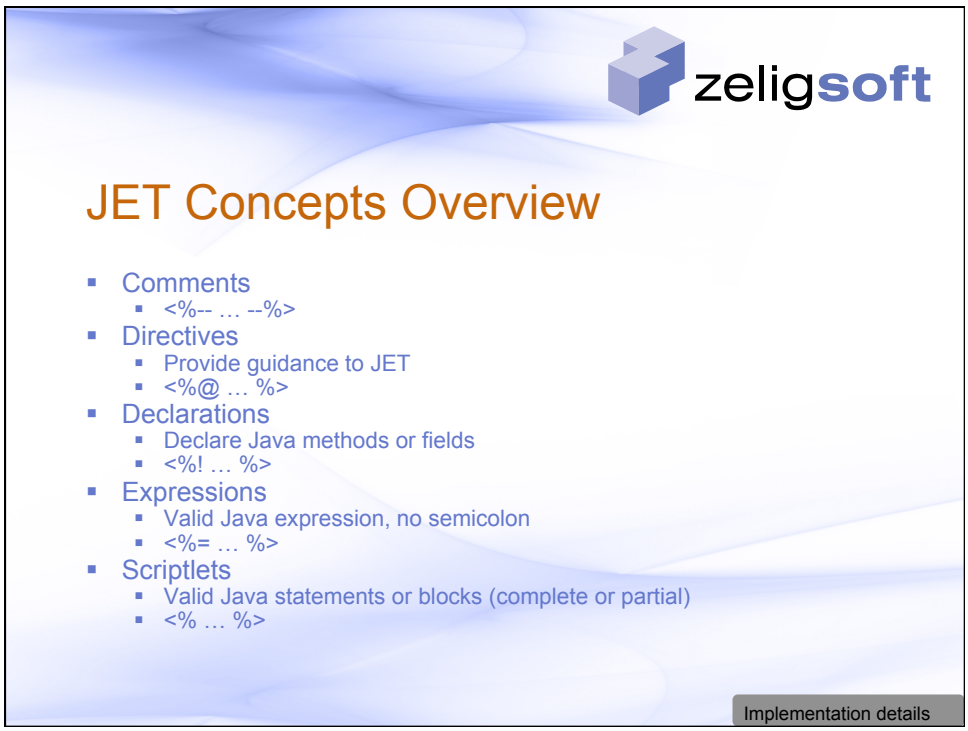
Integrating with RSA-RTE
Contribute an action
to the Project Explorer context menu
to the Diagram Editor context menu
Implement action handler
Class that implements IEditorActionDelegate
Test
In runtime workbench
Deploy
Publish the plug-in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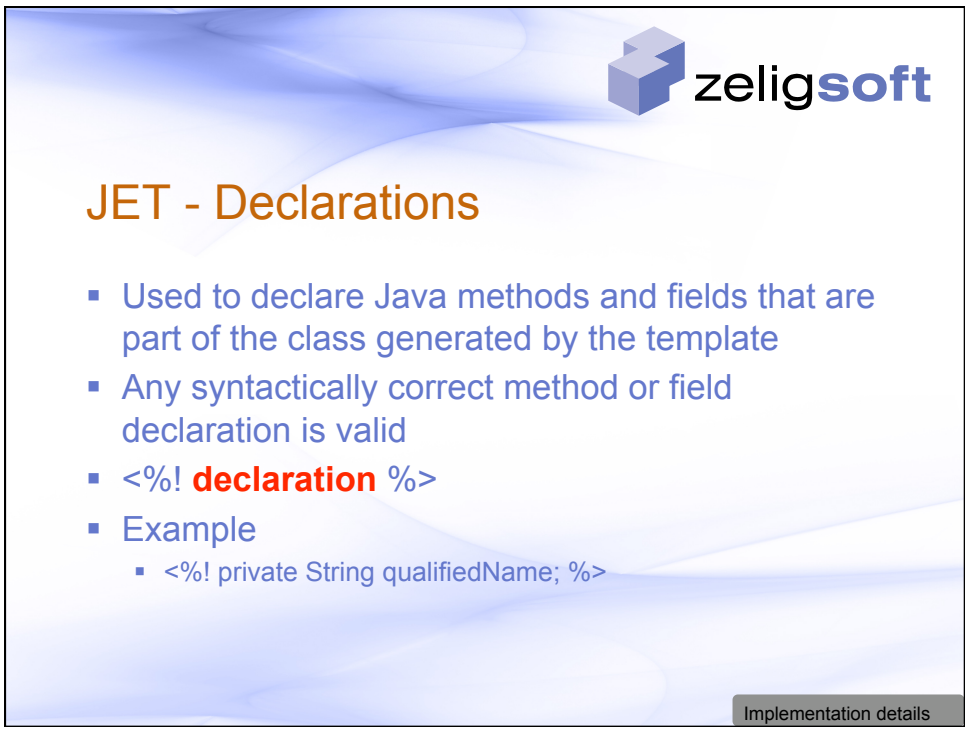
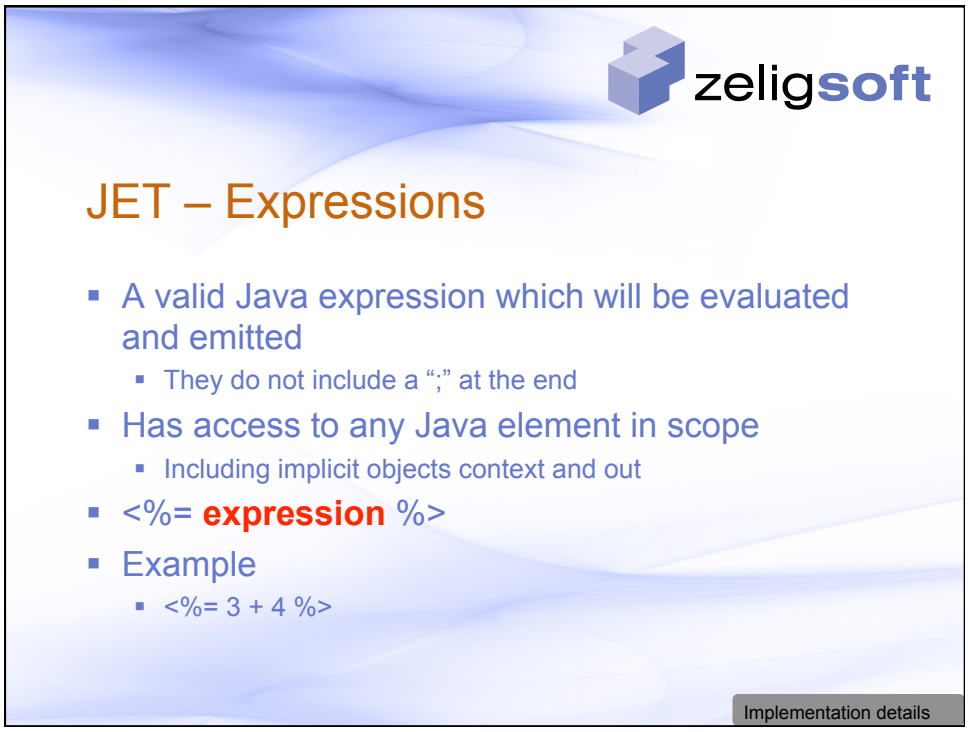
JET Concepts Overview
Comments
<%-- … --%>
Directives
Provide guidance to JET
<%@ … %>
Declarations
Declare Java methods or fields
<%! … %>
Expressions
Valid Java expression, no semicolon
<%= … %>
Scriptlets
Valid Java statements or blocks (complete or partial)
<% … %>
Implementation details



Toby McClean, Zeligsoft, 2008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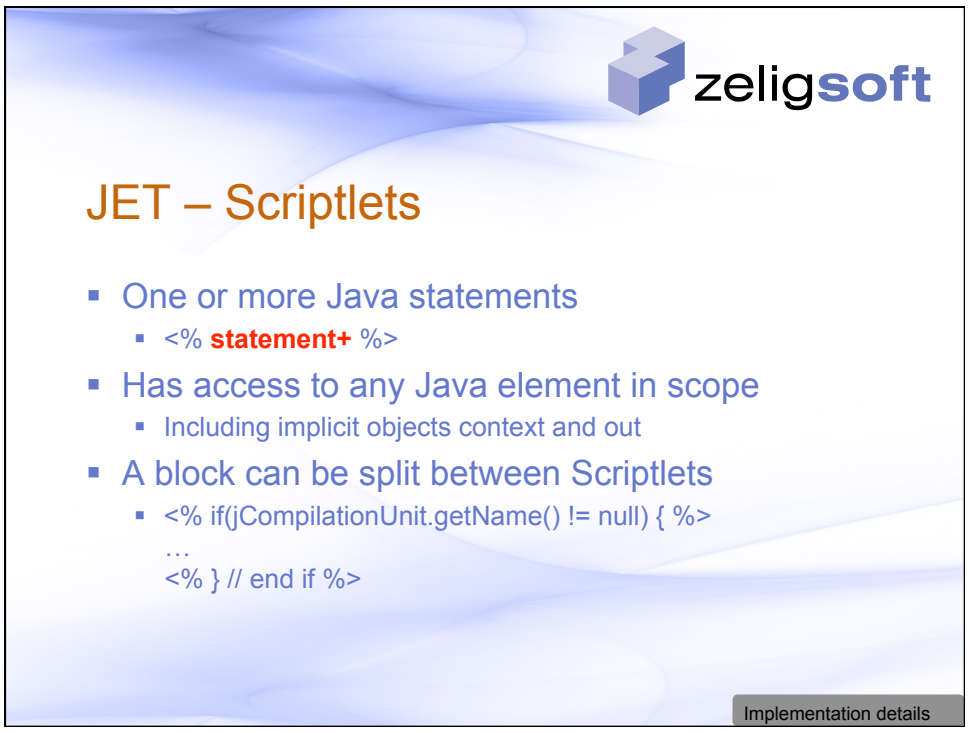
JET – Expressions
A valid Java expression which will be evaluated and emitted
They do not include a ";" at the end
Has access to any Java element in scope
Including implicit objects context and out
<%= expression %>
Example
<%= 3 + 4 %>
Implementation details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JET – Scriptlets
One or more Java statements
<% statement+ %>
Has access to any Java element in scope
Including implicit objects context and out
A block can be split between Scriptlets
<% if(jCompilationUnit.getName() != null) { %>
…
<% } // end if %>
Implementation details

zeligsoft

JET - Metamodels

- By default JET is setup to work with XML files
- To work with EMF models
  - In the transform extension specify model loader as org.eclipse.jet.emf.modelLoader
- To work with a specific metamodel
  - Add its Java package to the imports list of the template
    - <%@jet imports="org.eclipse.emf.java.*" %>
  - Can use the schema for an EMF model to control inputs

```
<transform
    modelLoader="org.eclipse.jet.emf"
    modelSchema="emf.java.xsd"
    startTemplate="templates/main.jet"
    templateLoaderClass="com.eett.exercises.m2t.jet.co
  <description></description>
  <tagLibraries>
```

Implementation details

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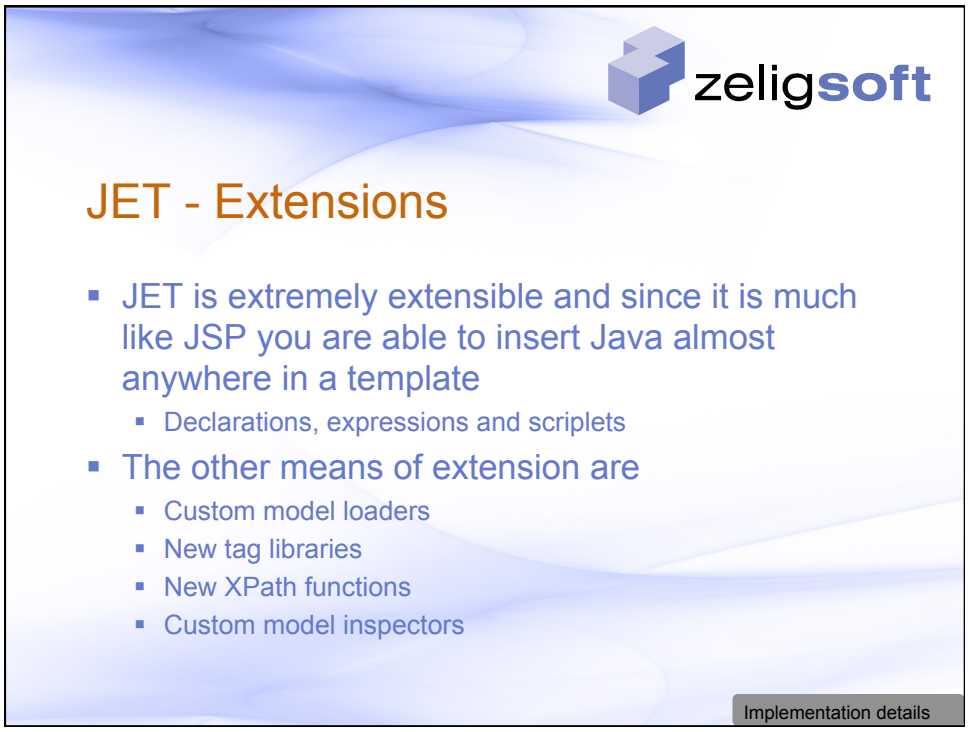
JET – Loading Models

- Tags in JET used to load content
  - Load the content into a variable so it can be referenced
- c:load
  - Loads the referenced model into a specified variable
  - Can be referenced through the variable after that
- c:loadContent
  - Load the content of the tag into the specified variable as XML

Implementation details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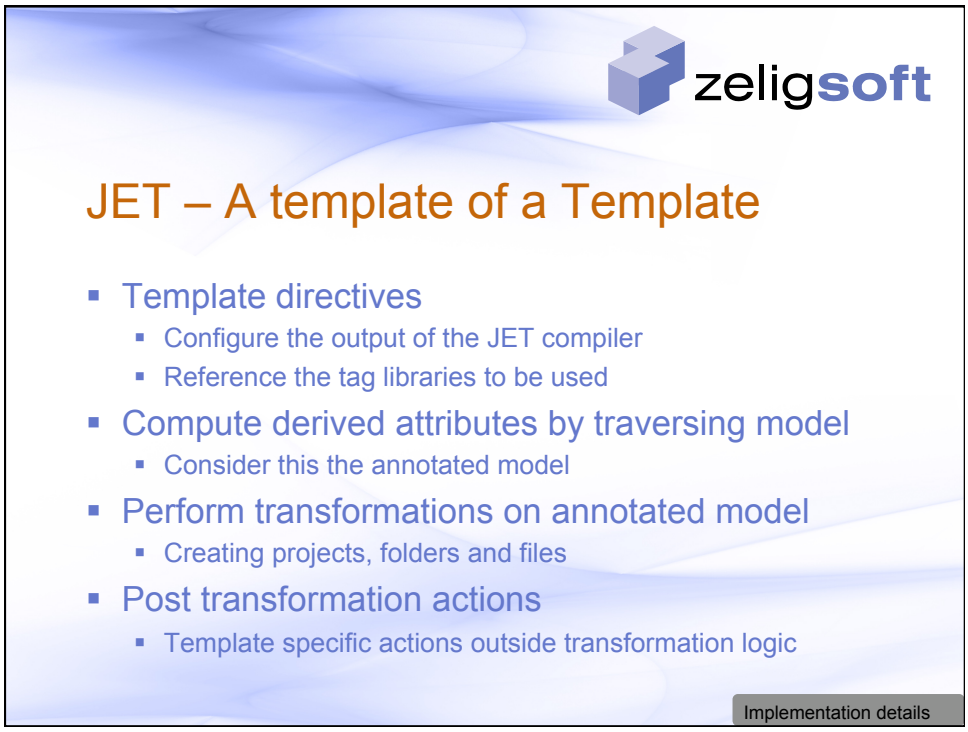
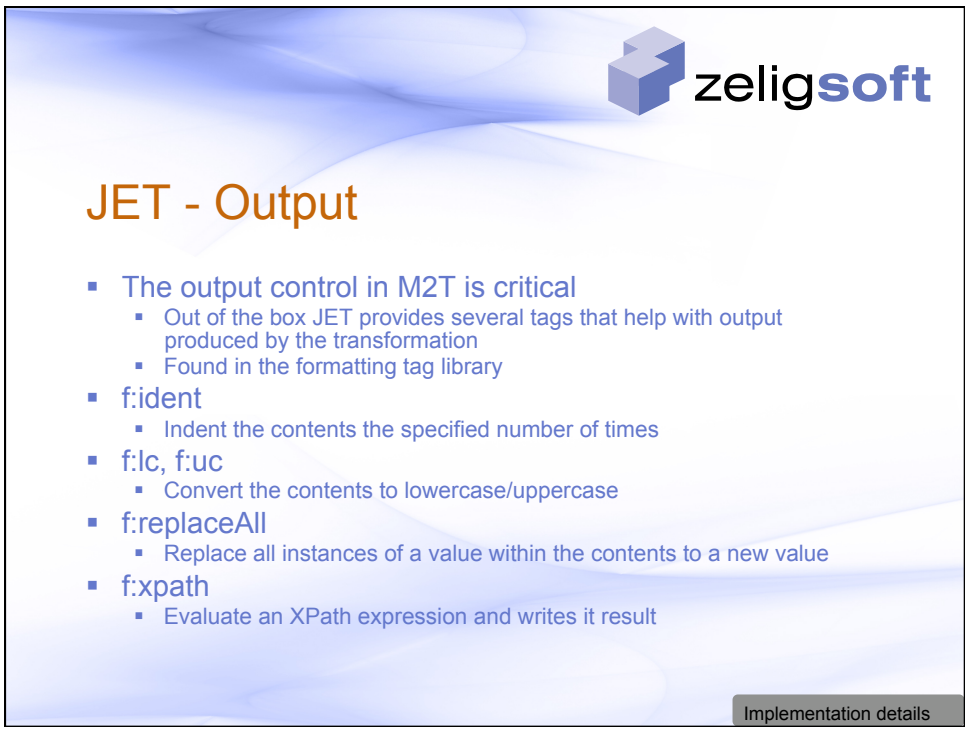
JET - Extensions
JET is extremely extensible and since it is much like JSP you are able to insert Java almost anywhere in a template
Declarations, expressions and scriplets
The other means of extension are
Custom model loaders
New tag libraries
New XPath functions
Custom model inspectors
Implementation details


zeligsoft
JET - Templates
A template in JET is defined in a file
There is a 1 to 1 mapping between file and template
Directives configure the template
@jet
affects the code created by the JET compiler
package
class
imports
startTag
endTag
@taglib
imports a tag library for use in the template and assigns it a namespace prefix
Implementation details





Toby McClean, Zeligsoft, 2008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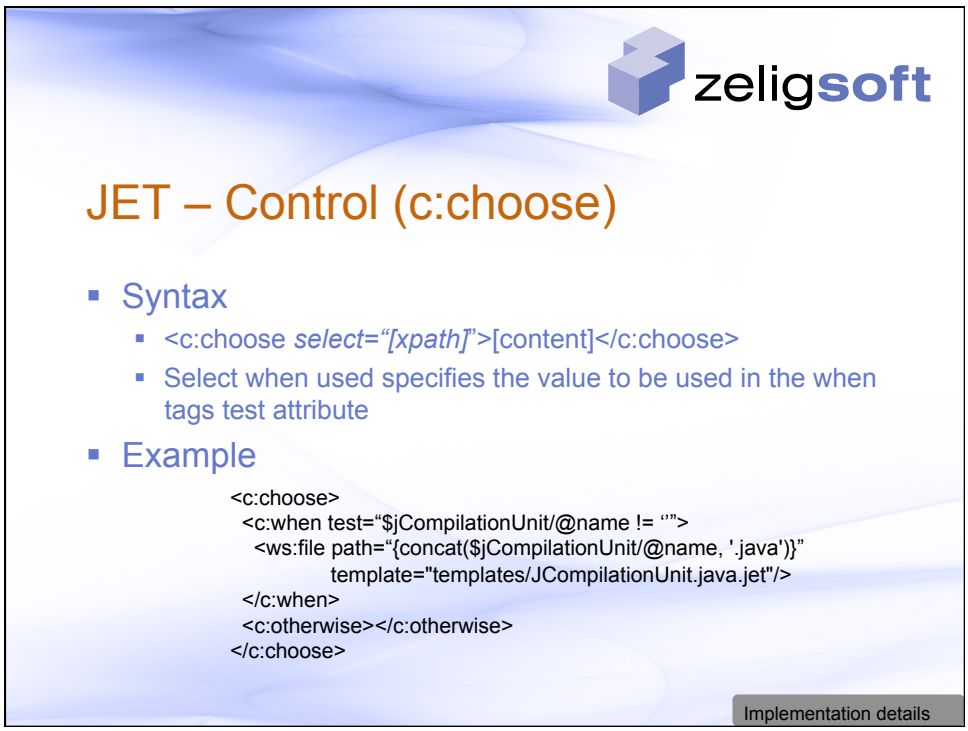
JET - Control
The control tag library provides capabilities for putting control logic into your template
c:choose
A group of mutually exclusive choices
c:if
Only process the contents if a test condition is satisfied
c:iterate
Process the contents for each element specified by an XPath expression
If the XPath expression evaluates to a number that it iterates that number of times
Implementation details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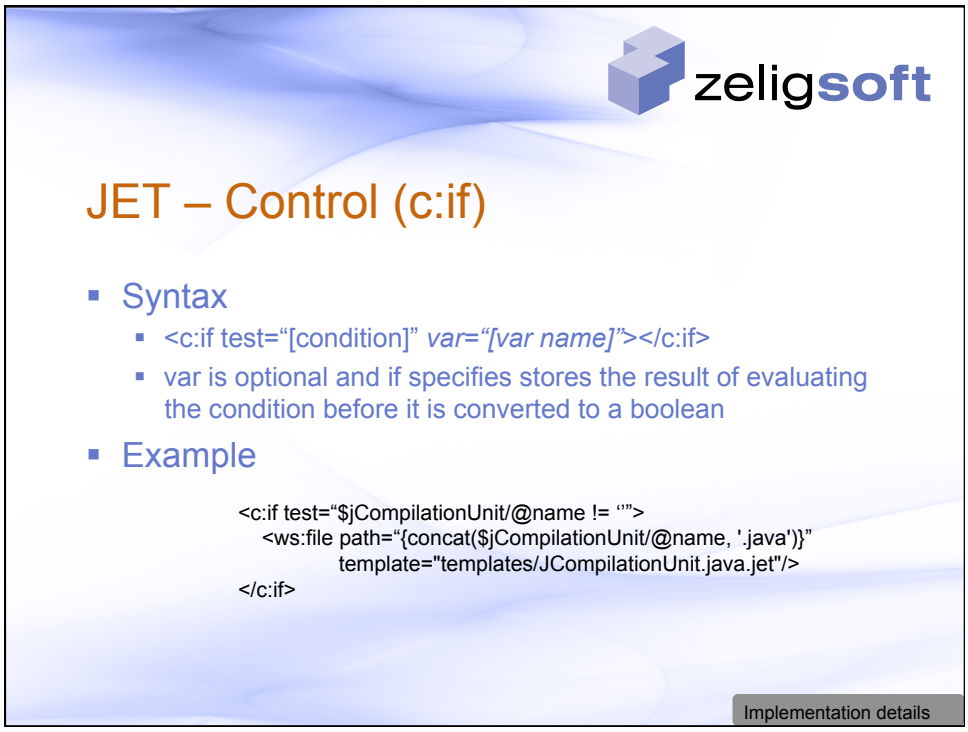
JET – Control (c:choose)
Syntax
<c:choose select="[xpath]">[content]</c:choose>
Select when used specifies the value to be used in the when tags test attribute
Example
<c:choose>
<c:when test="$jCompilationUnit/@name != ''">
<ws:file path="{concat($jCompilationUnit/@name, '.java')}"
template="templates/JCompilationUnit.java.jet"/>
</c:when>
<c:otherwise></c:otherwise>
</c:choose>
Implementation details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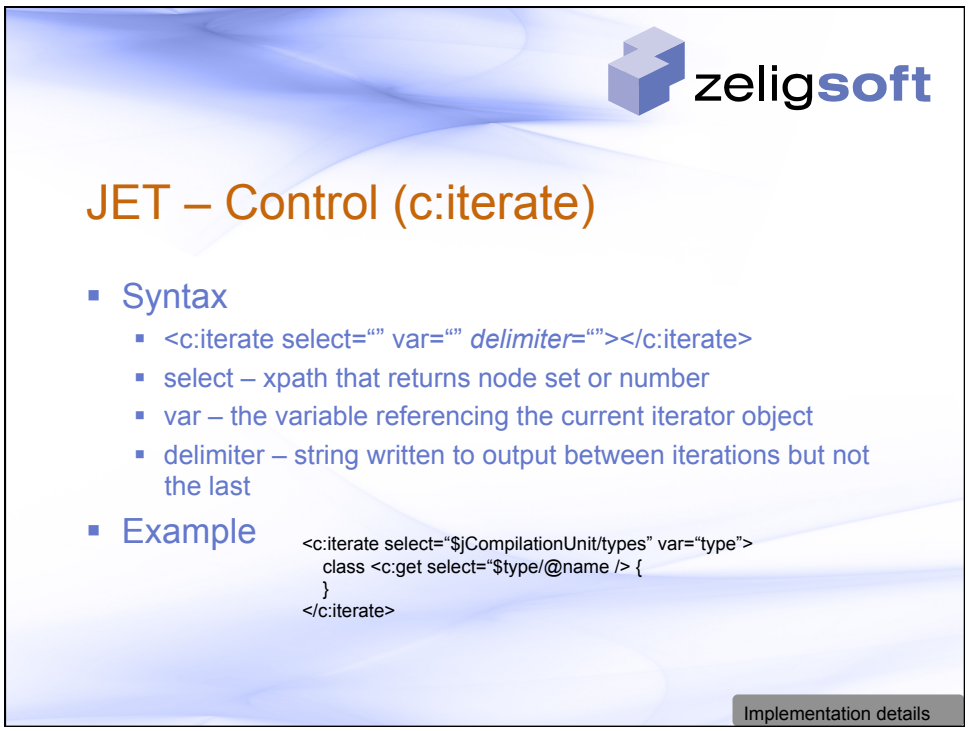
JET – Control (c:if)
Syntax
<c:if test="[condition]" var="[var name]"></c:if>
var is optional and if specifies stores the result of evaluating the condition before it is converted to a boolean
Example
<c:if test="$jCompilationUnit/@name != ''">
<ws:file path="{concat($jCompilationUnit/@name, '.java')}"
template="templates/JCompilationUnit.java.jet"/>
</c:if>
Implementation details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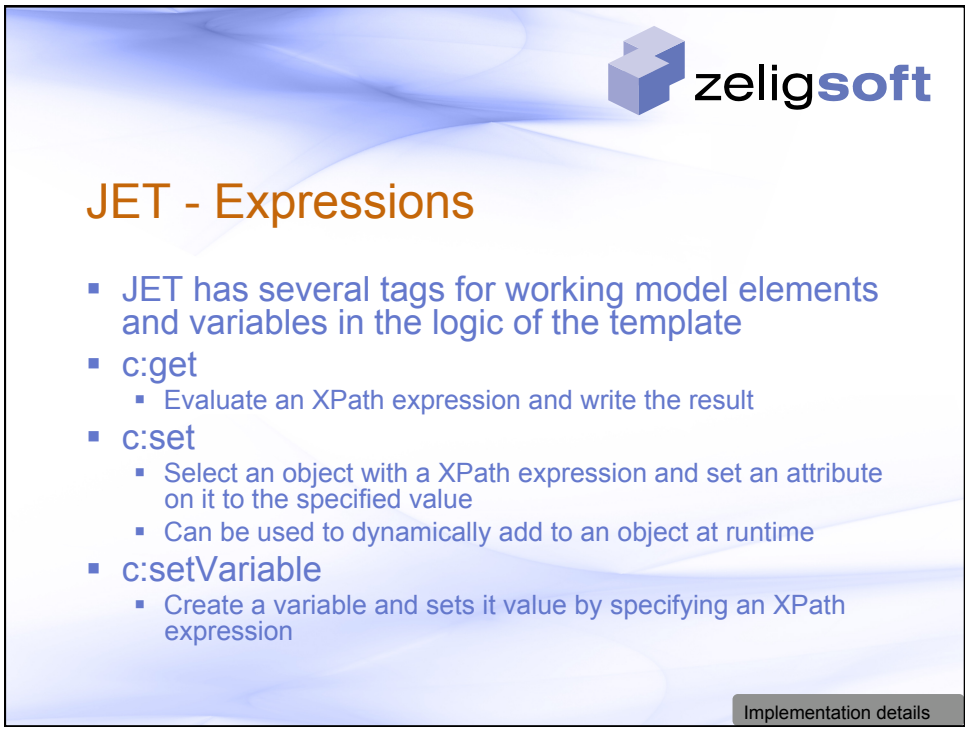
JET – Control (c:iterate)
Syntax
<c:iterate select="" var="" delimiter=""></c:iterate>
select – xpath that returns node set or number
var – the variable referencing the current iterator object
delimiter – string written to output between iterations but not the last
Example
<c:iterate select="$jCompilationUnit/types" var="type">
class <c:get select="$type/@name /> {
}
</c:iterate>
Implementation details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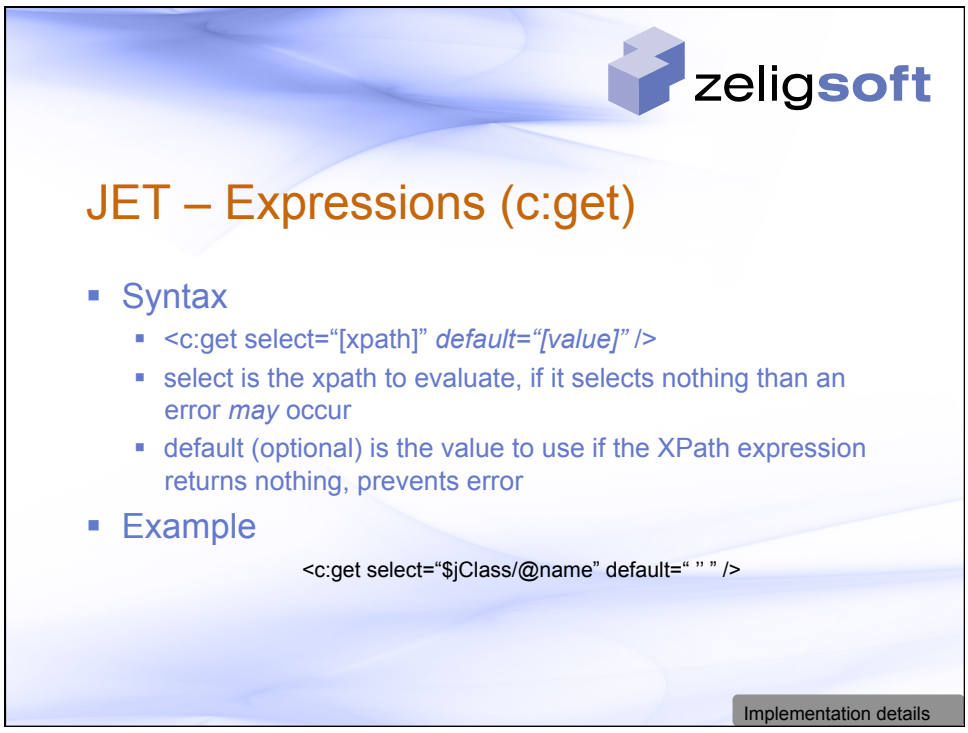
JET - Expressions
JET has several tags for working model elements and variables in the logic of the template
c:get
Evaluate an XPath expression and write the result
c:set
Select an object with a XPath expression and set an attribute on it to the specified value
Can be used to dynamically add to an object at runtime
c:setVariable
Create a variable and sets it value by specifying an XPath expression
Implementation details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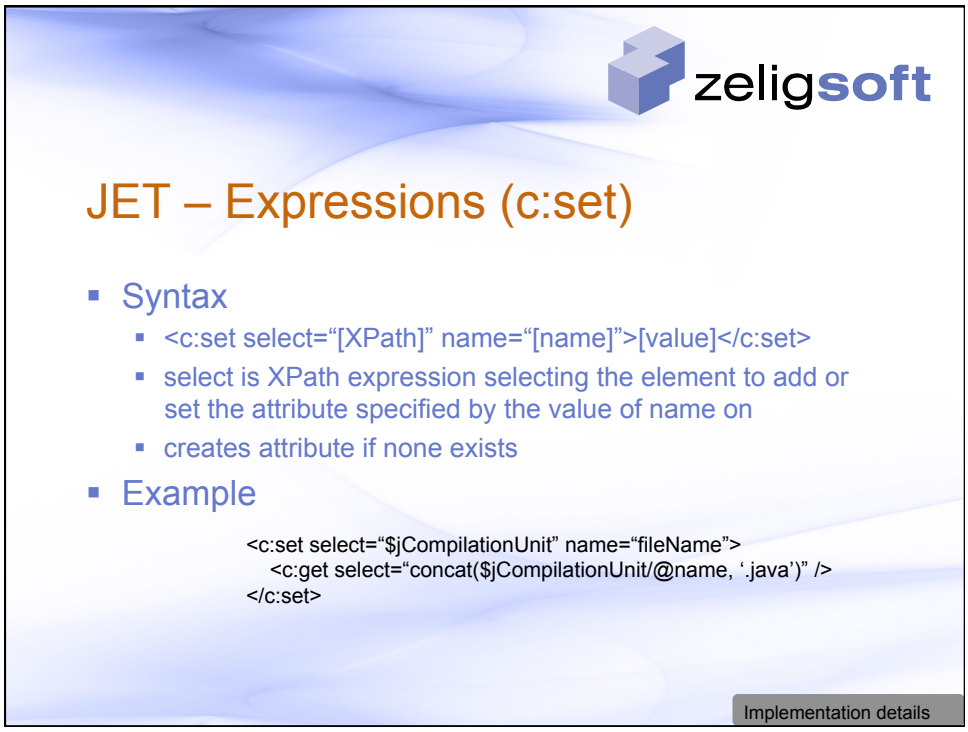
JET – Expressions (c:get)
Syntax
<c:get select="[xpath]" default="[value]" />
select is the xpath to evaluate, if it selects nothing than an error may occur
default (optional) is the value to use if the XPath expression returns nothing, prevents error
Example
<c:get select="$jClass/@name" default=" " " />
Implementation details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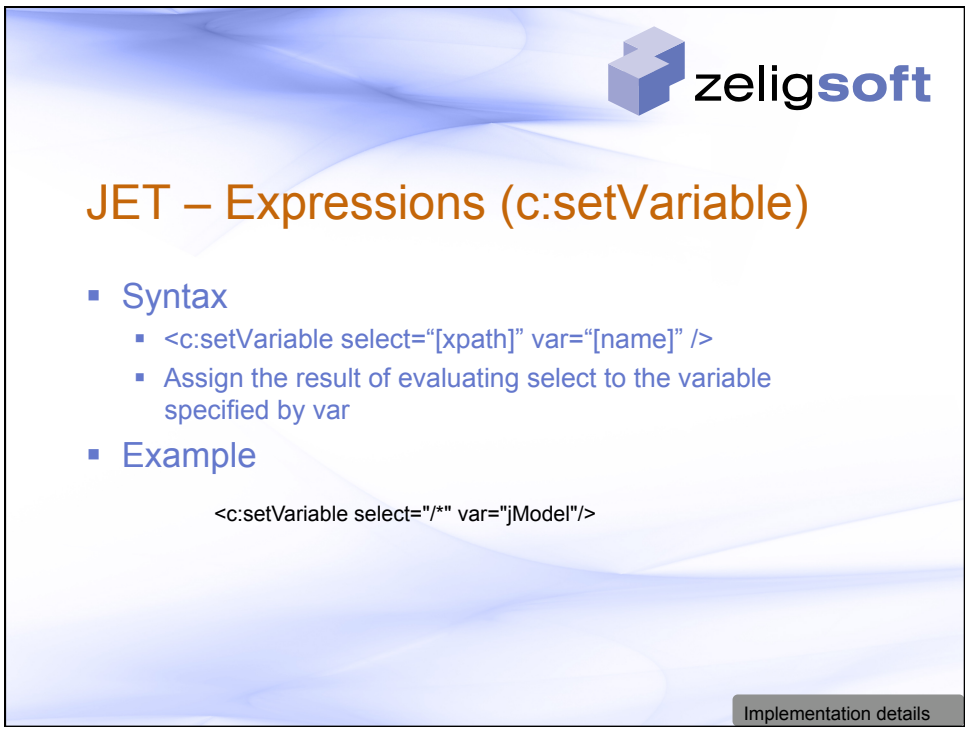
JET – Expressions (c:set)
Syntax
<c:set select="[XPath]" name="[name]">[value]</c:set>
select is XPath expression selecting the element to add or set the attribute specified by the value of name on
creates attribute if none exists
Example
<c:set select="$jCompilationUnit" name="fileName">
<c:get select="concat($jCompilationUnit/@name, '.java')" />
</c:set>
Implementation details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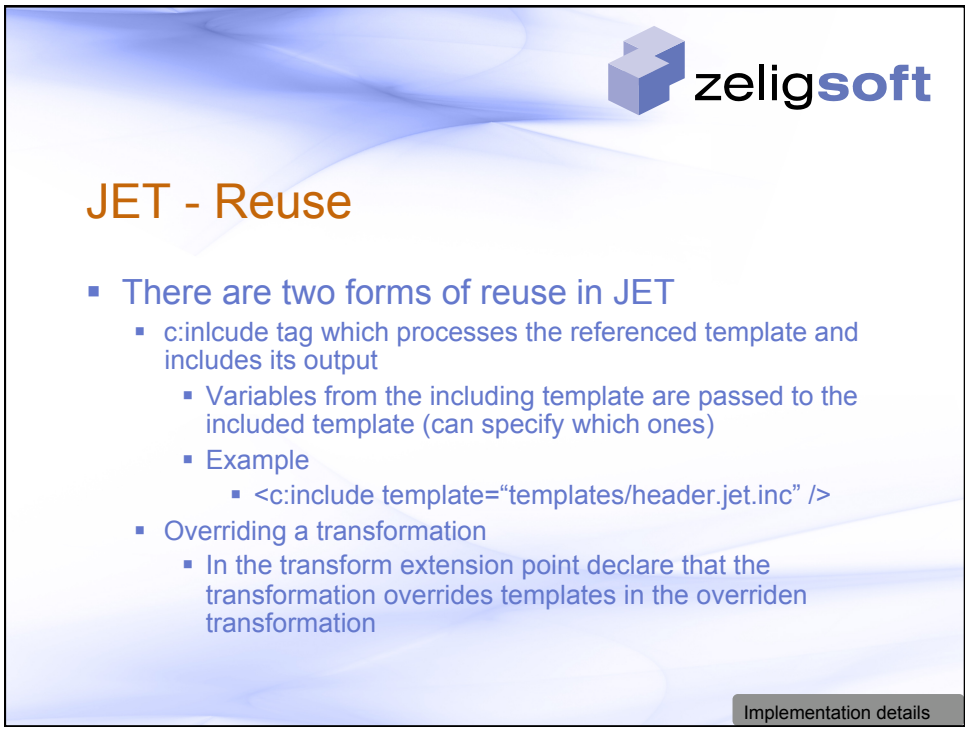
JET – Expressions (c:setVariable)
Syntax
<c:setVariable select="[xpath]" var="[name]" />
Assign the result of evaluating select to the variable specified by var
Example
<c:setVariable select="/*" var="jModel"/>
Implementation details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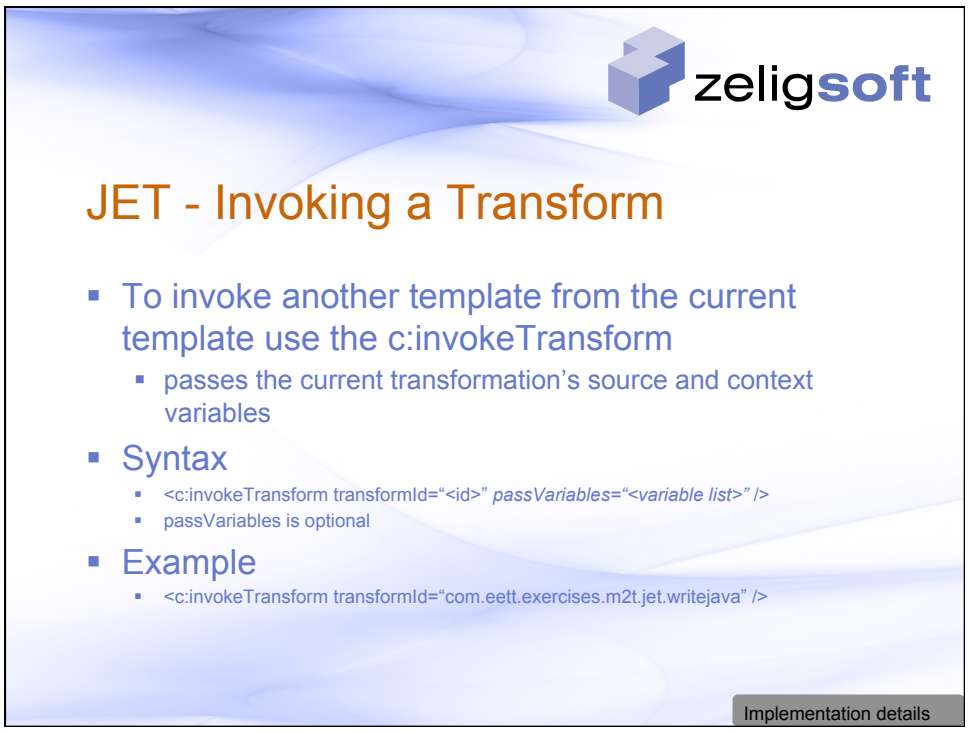
JET - Reuse
There are two forms of reuse in JET
c:inlcude tag which processes the referenced template and includes its output
Variables from the including template are passed to the included template (can specify which ones)
Example
<c:include template="templates/header.jet.inc" />
Overriding a transformation
In the transform extension point declare that the transformation overrides templates in the overriden transformation
Implementation details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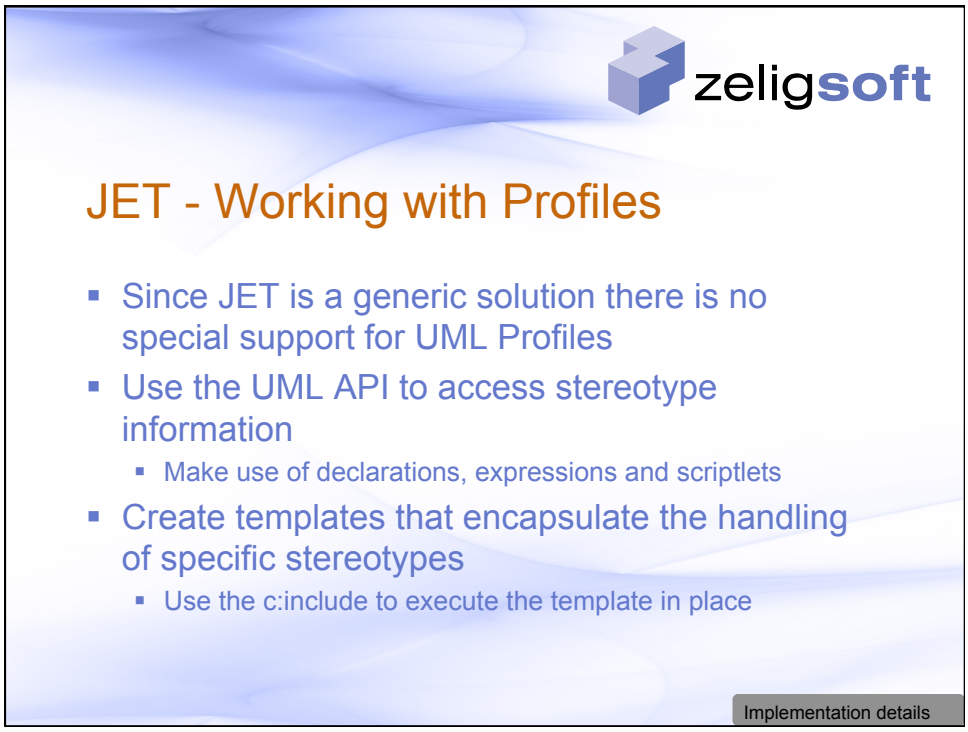
JET - Invoking a Transform
To invoke another template from the current template use the c:invokeTransform
passes the current transformation's source and context variables
Syntax
<c:invokeTransform transformId="<id>" passVariables="<variable list>" />
passVariables is optional
Example
<c:invokeTransform transformId="com.eett.exercises.m2t.jet.writejava" />
Implementation details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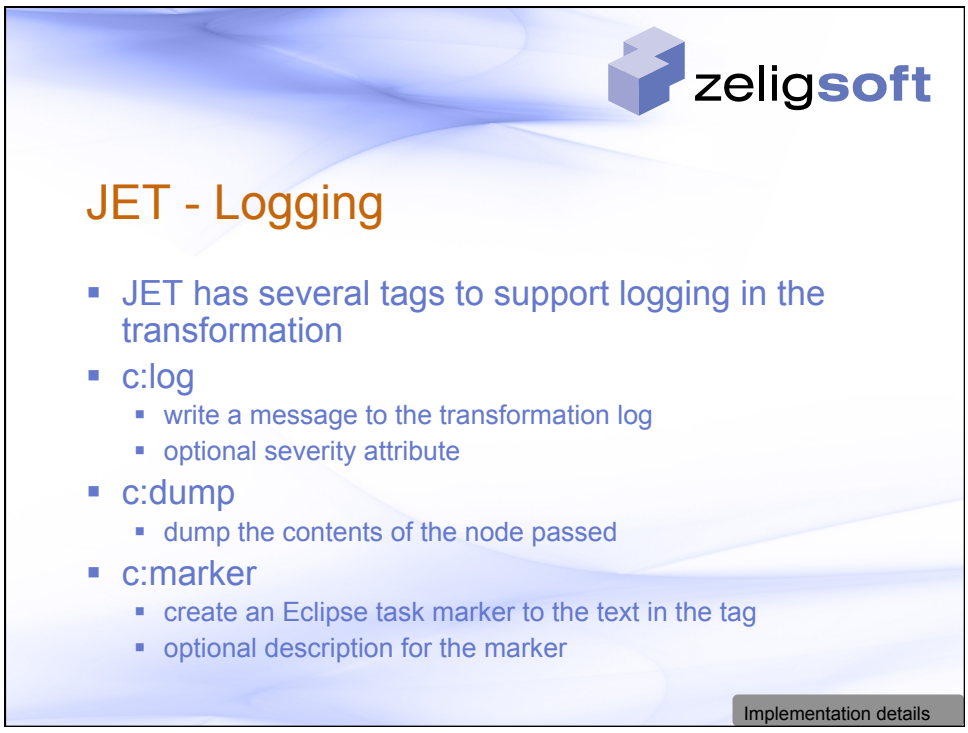
JET - Working with Profiles
Since JET is a generic solution there is no special support for UML Profiles
Use the UML API to access stereotype information
Make use of declarations, expressions and scriptlets
Create templates that encapsulate the handling of specific stereotypes
Use the c:include to execute the template in place
Implementation details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JET - Logging
JET has several tags to support logging in the transformation
c:log
write a message to the transformation log
optional severity attribute
c:dump
dump the contents of the node passed
c:marker
create an Eclipse task marker to the text in the tag
optional description for the marker
Implementation details


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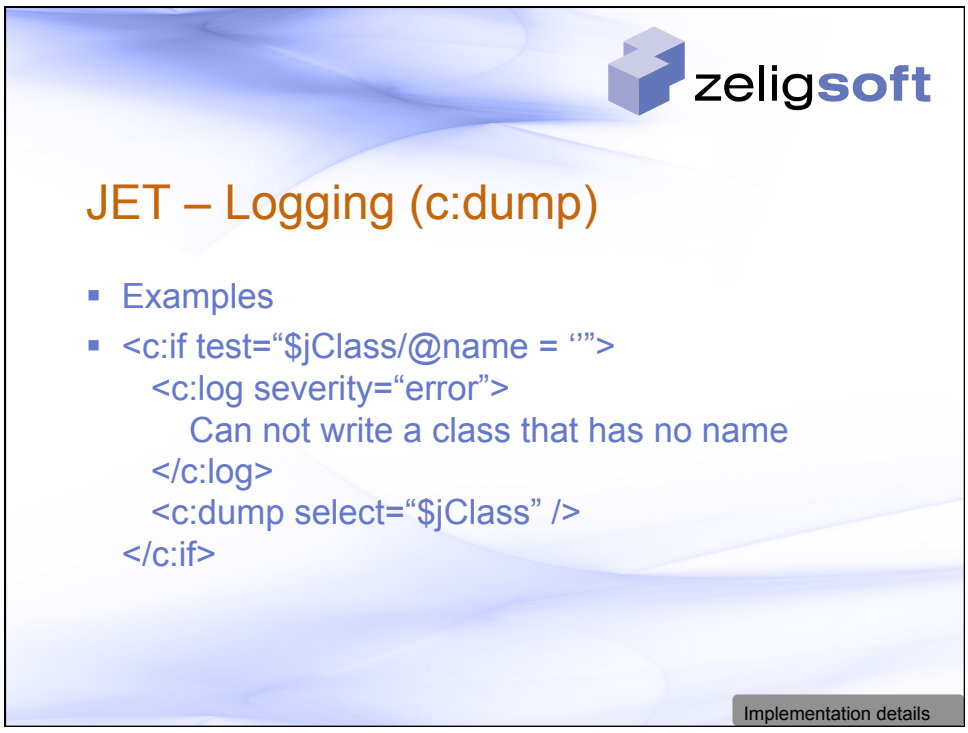
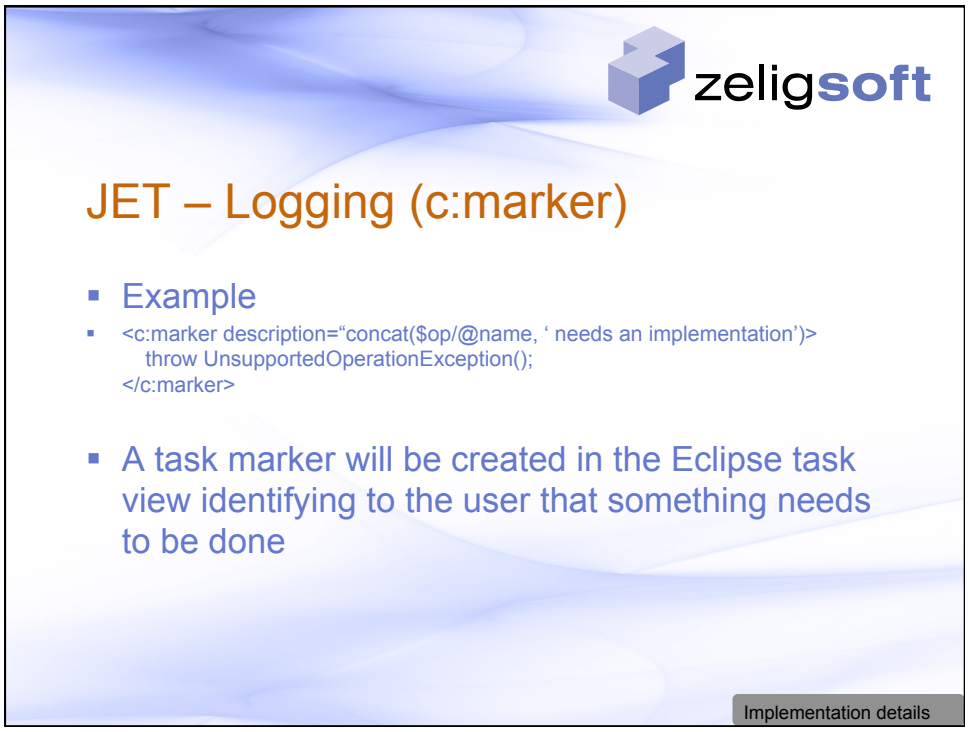
JET – Logging (c:log)
Examples
<c:if test="$jClass/@name = ''">
<c:log severity="error">
Can not write a class that has no name
</c:log>
</c:if>
<c:log>
Writing <c:get select="$jClass/@name" />
</c:log>
Implementation details


zeligsoft
JET – Logging (c:dump)
Examples
<c:if test="$jClass/@name = ''">
<c:log severity="error">
Can not write a class that has no name
</c:log>
<c:dump select="$jClass" />
</c:if>
Implementation details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JET – Logging (c:marker)
Example
<c:marker description="concat($op/@name, ' needs an implementation')>
throw UnsupportedOperationException();
</c:marker>
A task marker will be created in the Eclipse task view identifying to the user that something needs to be done
Implementation details


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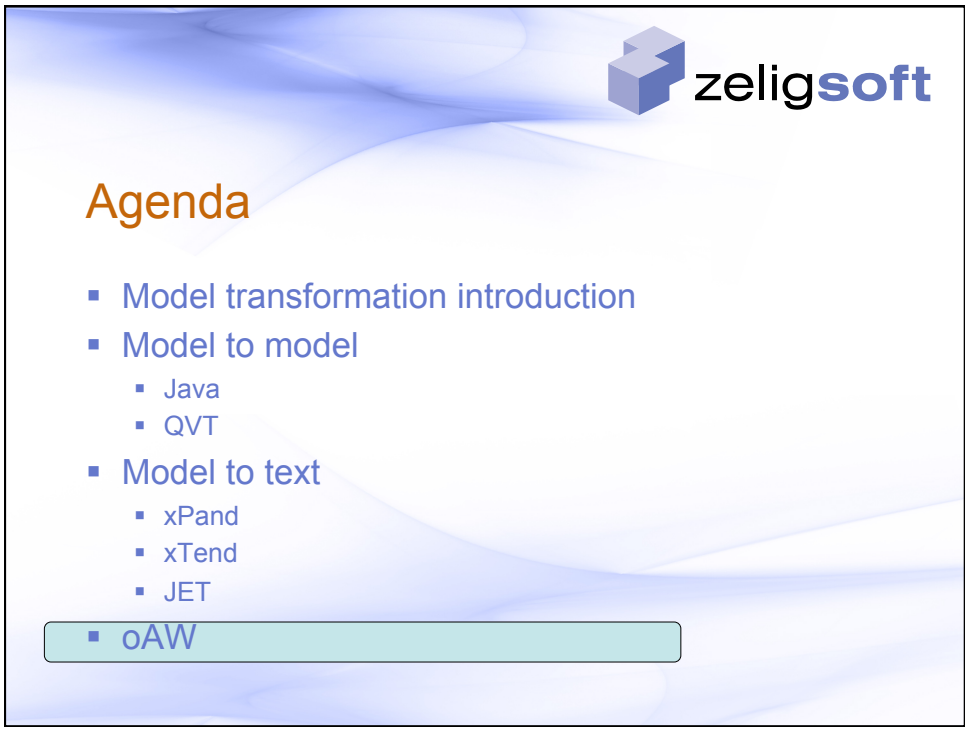
Summary
We have explored JET
What is JET
How I develop a model to text transformation with JET
How is my transformation integrated with Eclipse
The features and syntax of JET
You should now be able to
Do the JET exercises
Navigate around the JET documentation and other resources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Agenda
Model transformation introduction
Model to model
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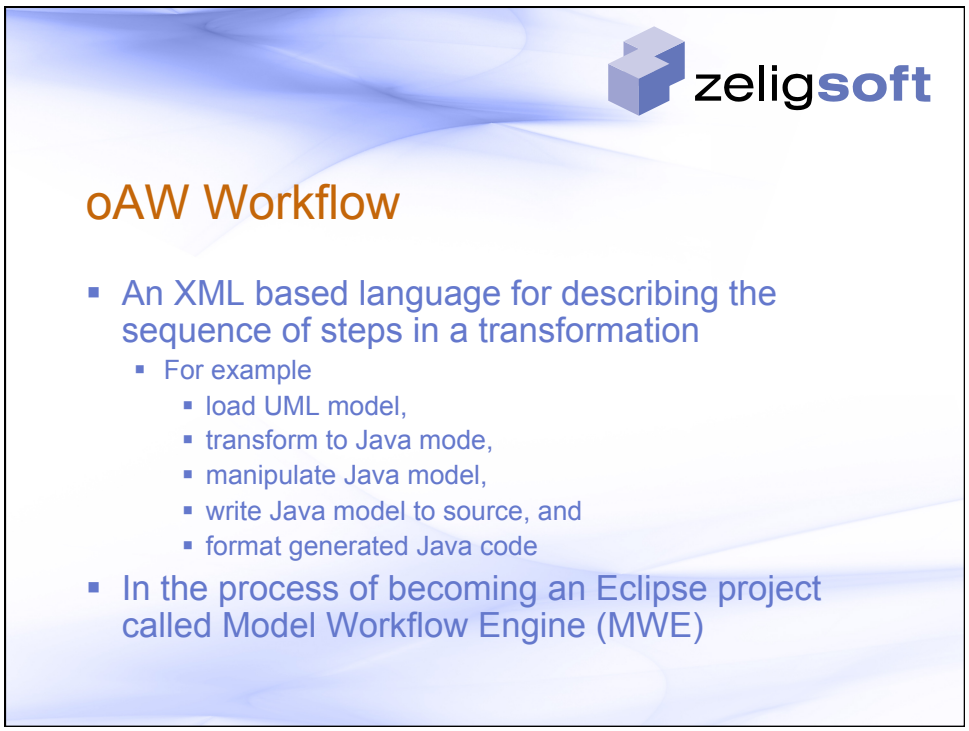
xTend
JET
oAW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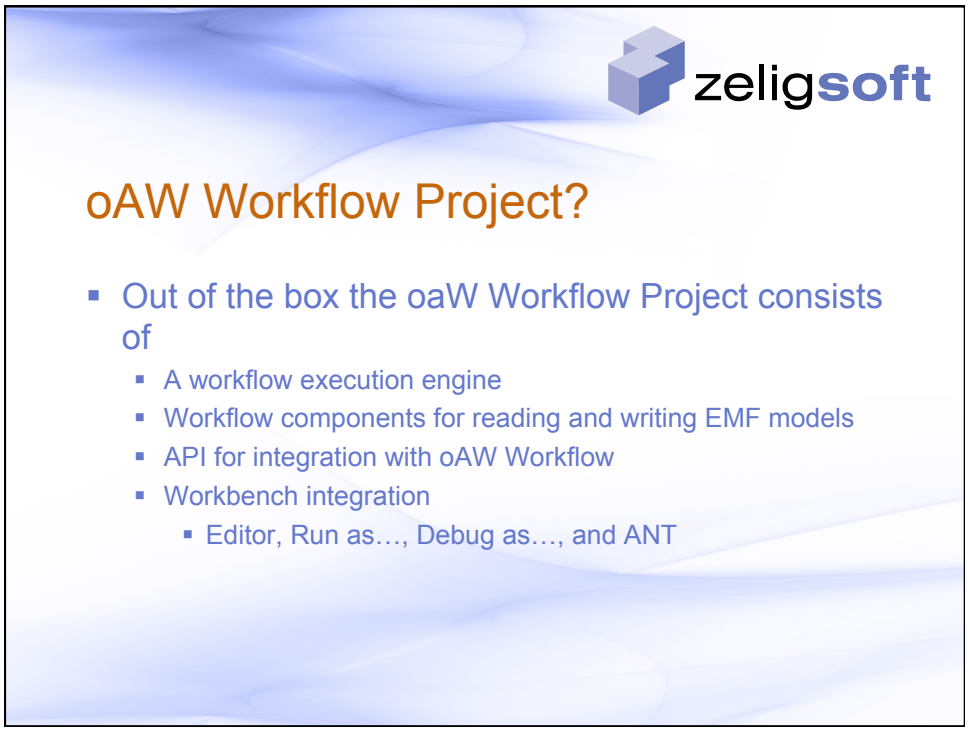
oAW Workflow
An XML based language for describing the sequence of steps in a transformation
For example
load UML model,
transform to Java mode,
manipulate Java model,
write Java model to source, and
format generated Java code
In the process of becoming an Eclipse project called Model Workflow Engine (MWE)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oAW Workflow Project?
Out of the box the oaW Workflow Project consists of
A workflow execution engine
Workflow components for reading and writing EMF models
API for integration with oAW Workflow
Workbench integration
Editor, Run as…, Debug as…, and ANT


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More oAW Workflow Project?
API allows for custom workflow components
e.g. QVT transformation execution
Configuration properties
Properties passed into the workflow
<property name='targetDir' value='src-gen/'/>
Slots or variables
Simple syntax, variables are referred to by name
No declaration
<component id="generator" class="oaw.xtend.XtendComponent">
…
<outputSlot value="javaModel" />
</component>

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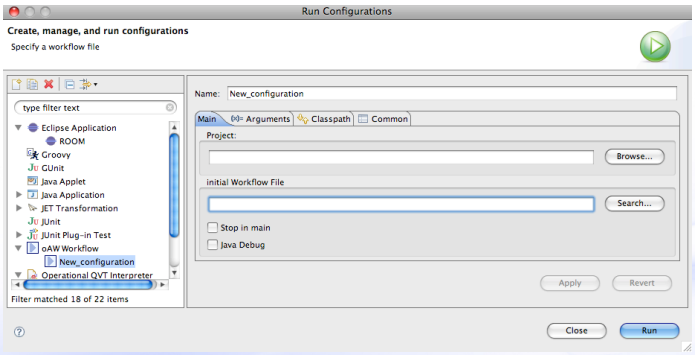
Executing an oAW Workflow

- The oAW Workflow Engine is integrated with Run as…



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Discussion

- We can combine the previous module and this module
  - Extend the model with additional information
  - Extend generation to use this information
  - May require RTS customization
- Examples?
  - Deadlines in messages
  - Port patterns

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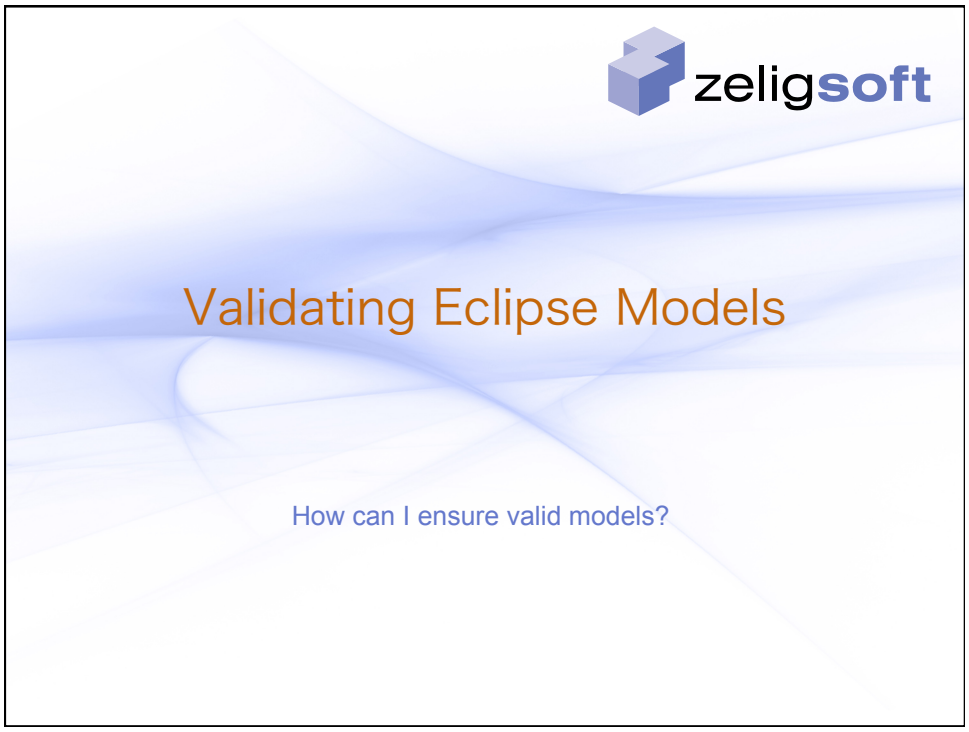
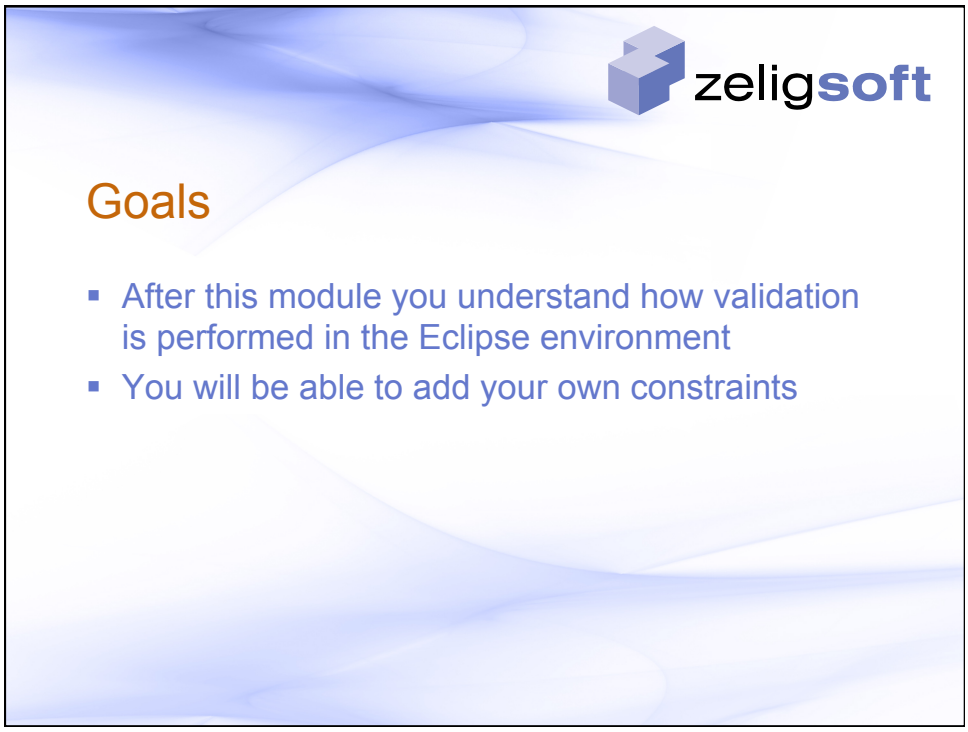
Questions



Toby McClean, Zeligsoft, 2008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Goals
After this module you understand how validation is performed in the Eclipse environment
You will be able to add your own constraints


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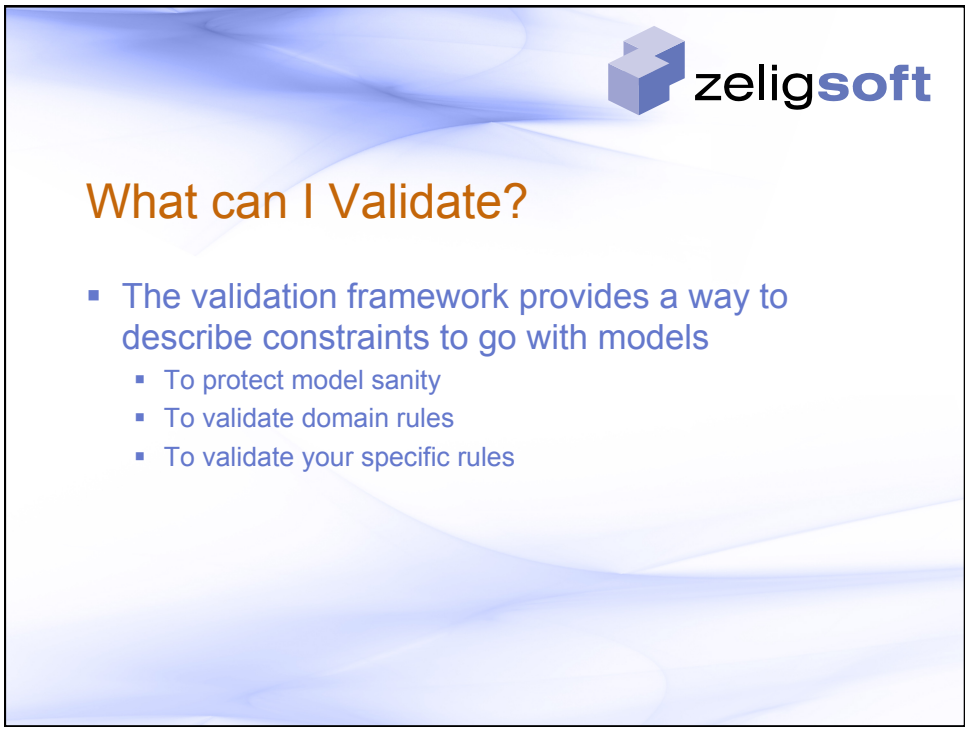
Agenda
Overview
Static and dynamic constraint providers
Constraints
Validation service
Creating constraints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What can I Validate?
The validation framework provides a way to describe constraints to go with models
To protect model sanity
To validate domain rules
To validate your specific rules


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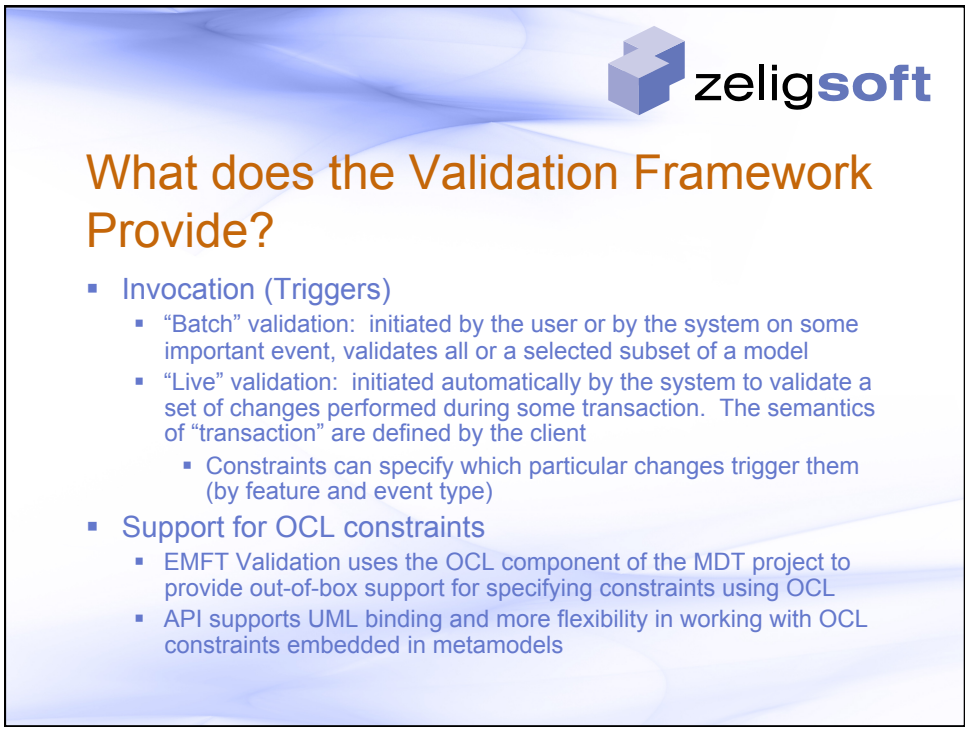
Validation Framework Overview
Constraints are organized through categories and bindings
Constraint providers contribute constraints
Constraint parsers implement implementation languages
Traversal strategies walk the model
Validation listeners are notified when validation occurs
Notification generators for custom (esp. higher-order) notifications for processing in live validation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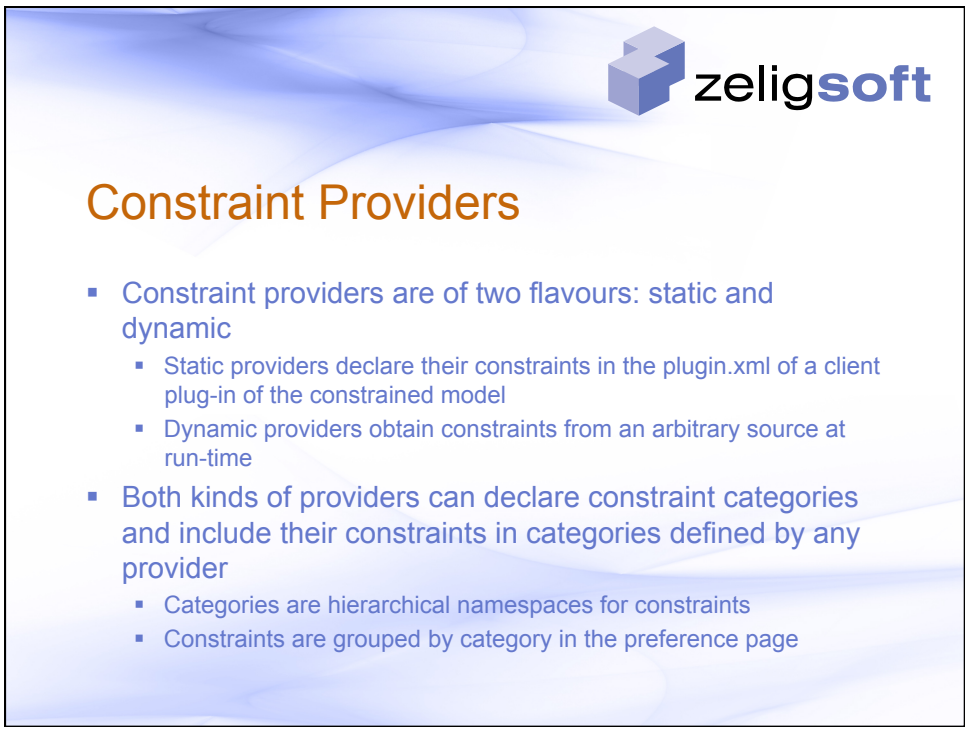
What does the Validation Framework Provide?
Invocation (Triggers)
"Batch" validation: initiated by the user or by the system on some important event, validates all or a selected subset of a model
"Live" validation: initiated automatically by the system to validate a set of changes performed during some transaction. The semantics of "transaction" are defined by the client
Constraints can specify which particular changes trigger them (by feature and event type)
Support for OCL constraints
EMFT Validation uses the OCL component of the MDT project to provide out-of-box support for specifying constraints using OCL
API supports UML binding and more flexibility in working with OCL constraints embedded in metamodels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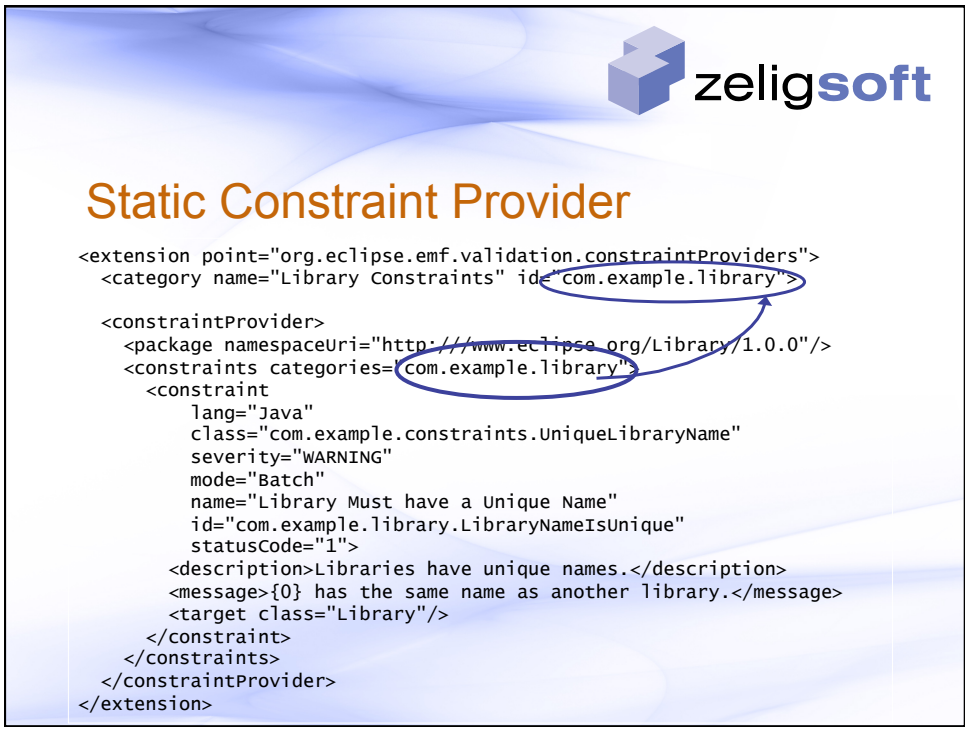
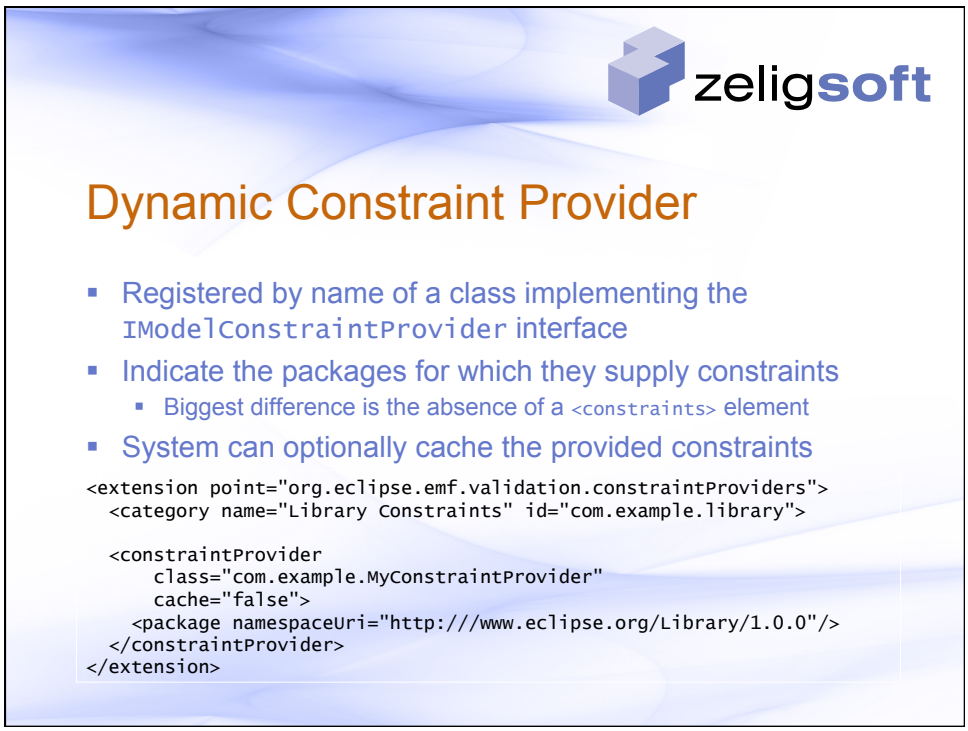
Constraint Providers
Constraint providers are of two flavours: static and dynamic
Static providers declare their constraints in the plugin.xml of a client plug-in of the constrained model
Dynamic providers obtain constraints from an arbitrary source at run-time
Both kinds of providers can declare constraint categories and include their constraints in categories defined by any provider
Categories are hierarchical namespaces for constraints
Constraints are grouped by category in the preference page





Toby McClean, Zeligsoft, 2008

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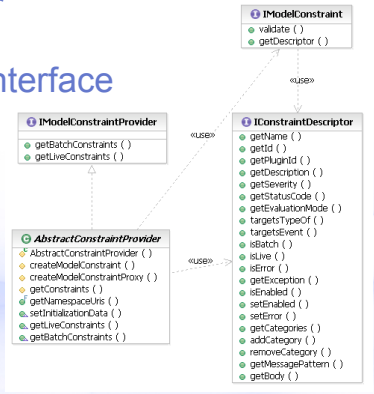
Dynamic Constraint Provider

- A dynamic constraint provider implements the `IModelConstraintProvider` interface
- A descriptor supplies meta-data about a constraint
- The validation algorithm is supplied by the constraint object in the `validate()` method



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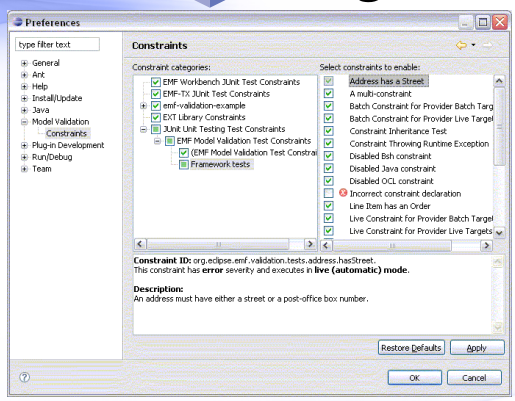
Constraints

- Descriptor provides:
  - ID and localizable name
  - Evaluation mode
  - Target EClasses
  - Triggering events (live)
  - Severity, error message
  - Categorization
  - Enabled state
- Much of this information appears in the preference page
- Users can choose which constraints to activate



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Evaluation Modes

- Batch validation is usually explicitly requested by the user, via a menu action or toolbar button
- Live validation is performed automatically as changes are made to EMF resources
  - Live constraints indicate which specific changes trigger them

```
<constraint
    mode="Live"
    … >
  <description>Libraries have unique names.</description>
  <message>{0} has the same name as: {1}.</message>
  <target class="Library">
     <event name="Set">
        <feature name="name"/>
     </event>
  </target>
</constraint>
```

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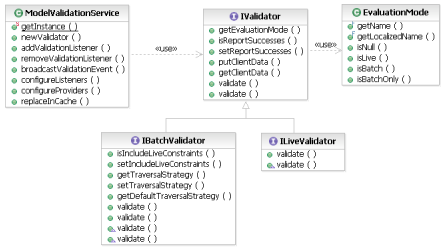
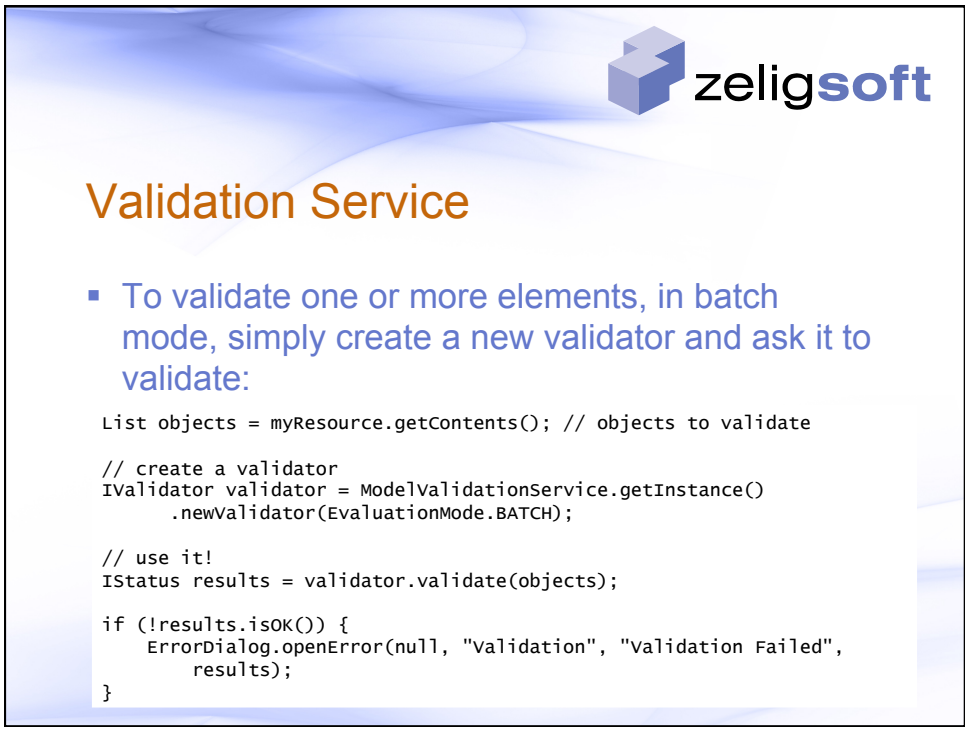
Validation Service

- Evaluation of constraints is performed via the Validation Service
- The service provides validators corresponding to the available evaluation modes
- By default, batch validation includes live constraints, also, for completeness



Toby McClean, Zeligsoft, 2008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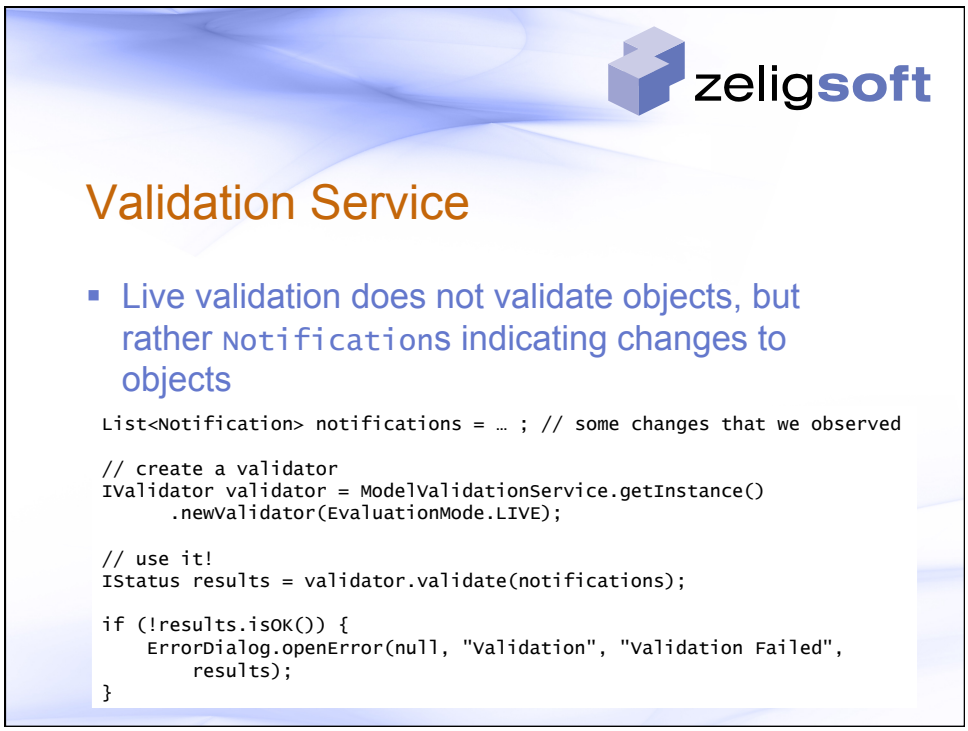
Validation Service
To validate one or more elements, in batch mode, simply create a new validator and ask it to validate:
List objects = myResource.getContents(); // objects to validate
// create a validator
IValidator validator = ModelValidationService.getInstance()
.newValidator(EvaluationMode.BATCH);
// use it!
IStatus results = validator.validate(objects);
if (!results.isOK()) {
ErrorDialog.openError(null, "Validation", "Validation Failed",
results);
}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Validation Service
Live validation does not validate objects, but rather Notifications indicating changes to objects
List<Notification> notifications = … ; // some changes that we observed
// create a validator
IValidator validator = ModelValidationService.getInstance()
.newValidator(EvaluationMode.LIVE);
// use it!
IStatus results = validator.validate(notifications);
if (!results.isOK()) {
ErrorDialog.openError(null, "Validation", "Validation Failed",
results);
}

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Creating Constraints

- Specifying a constraint doesn't necessarily require any code
- Requires the OCL component of the MDT project

```
<constraint
    lang="OCL"
    mode="Batch"
    … >
  <description>Libraries have unique names.</description>
  <message>{0} has the same name as: {1}.</message>
  <target class="Library"/>

  <![CDATA[
  Library.allInstances()->forAll(l |
       l <> self implies l.name <> self.name)
  ]]>

</constraint>
```

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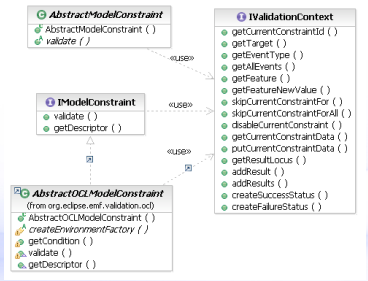
Creating Constraints

- Sometimes the easiest or best way to formulate a constraint is in Java
- Java constraints extend the `AbstractModelConstraint` class
- The validation context provides the `validate()` method with information about the validation operation



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Validation Context

- Provides the element being validated (the target)
- Indicates the current evaluation mode (live or batch)
  - In case of live invocation, provides the changed feature and the event type
- Allows constraints to cache arbitrary data for the duration of the current validation operation
- Provides convenient methods for reporting results
- Provides the ID of the constraint that is being invoked

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Creating Constraints

```
public class LibraryNameIsUnique extends AbstractConstraint {
  public IStatus validate(IValidationContext ctx) {
    Library target = (Library) ctx.getTarget(); // object to validate

    // does this library have a unique name?
    Set<Library> libs = findLibrariesWithName(target.getName());
    if (libs.size() > 1) {
       // report this problem against all like-named libraries
       ctx.addResults(libs);

       // don't need to validate these other libraries
       libs.remove(target);
       ctx.skipCurrentConstraintFor(libs);

       return ctx.createFailureStatus(new Object[] {
          target, libs});
    }

    return ctx.createSuccessStatus();
  }
}
```

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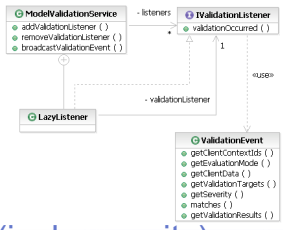
Listening for Validation Events



- Every validation operation executed by the Validation Service generates an event
- The event indicates the kind of validation performed, on what objects, and what were the results (incl. severity)
- Listeners registered on the extension point are lazily initialized when their selection criteria are met

```
<extension point="org.eclipse.emf.validation.validationListeners">
    <listener class="com.example.validation.ProblemsReporter">
        <clientContext id="com.example.MyClientContext"/>
    </listener>
</extension>
```

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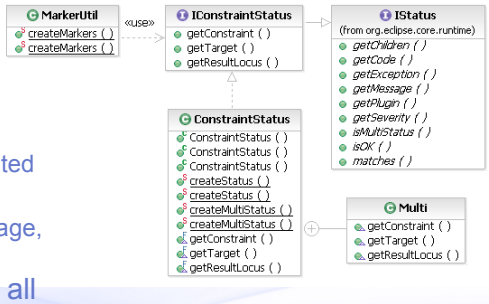
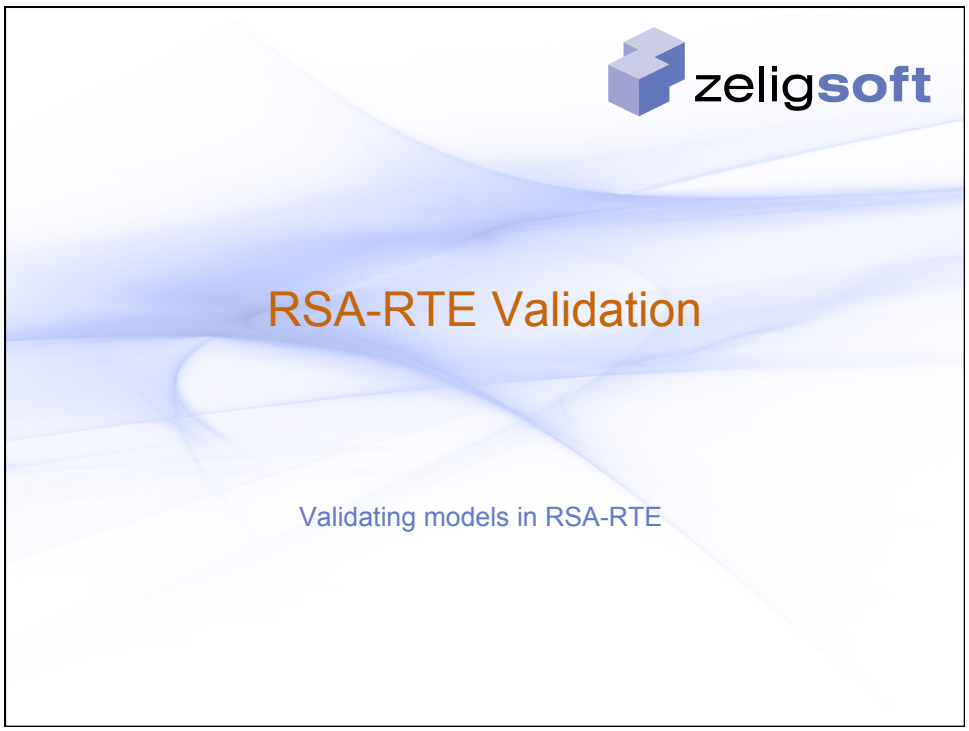
Reporting Problems



- Problems are reported as IConstraintStatus objects. A status knows:
  - The constraint that was violated
  - The objects that violated it
  - The severity and error message, as usual for an IStatus
- The marker utility encodes all of this information in a problem marker on the appropriate resource, to show in the Problems view



Toby McClean, Zeligsoft, 2008

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Overview

- Adding constraints to models in RSA-RTE
  - Authoring
  - Executing
- Adding constraints to profiles in RSA-RTE
  - Authoring
  - Executing

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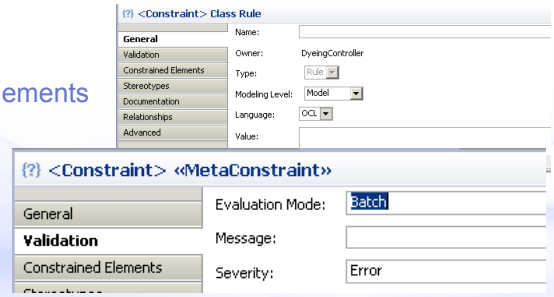
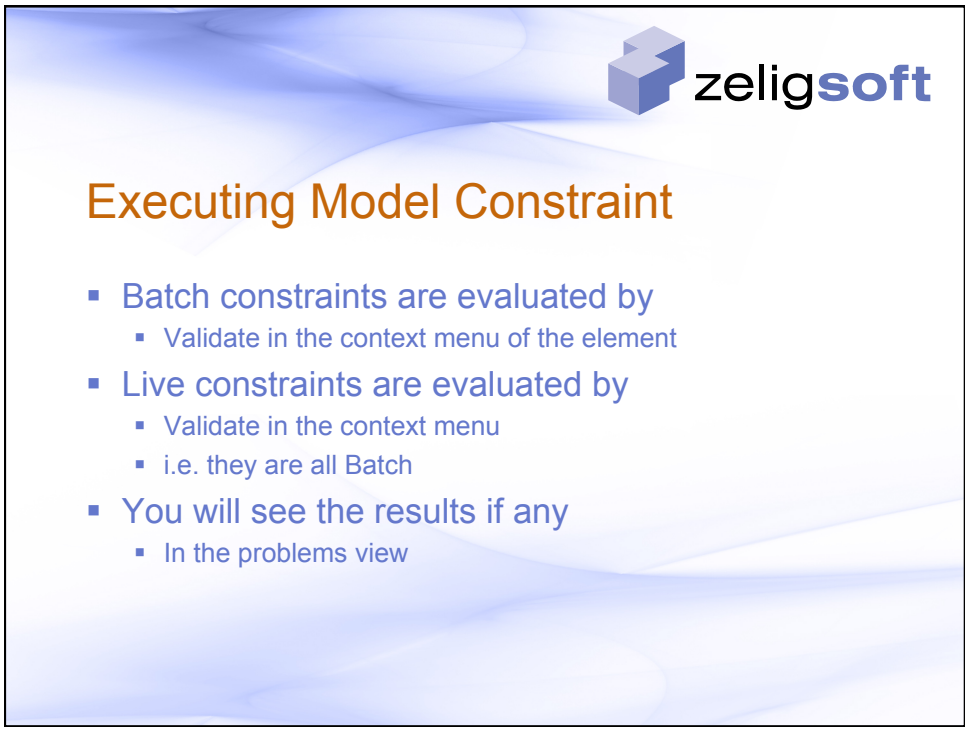
Authoring Model Constraint

- Contraints can be added to model elements
  - Add UML → Constraint from the elements context menu
  - Defined by
    - Name
    - Constrained elements
    - Modeling level
    - Language
    - Mode
    - Message

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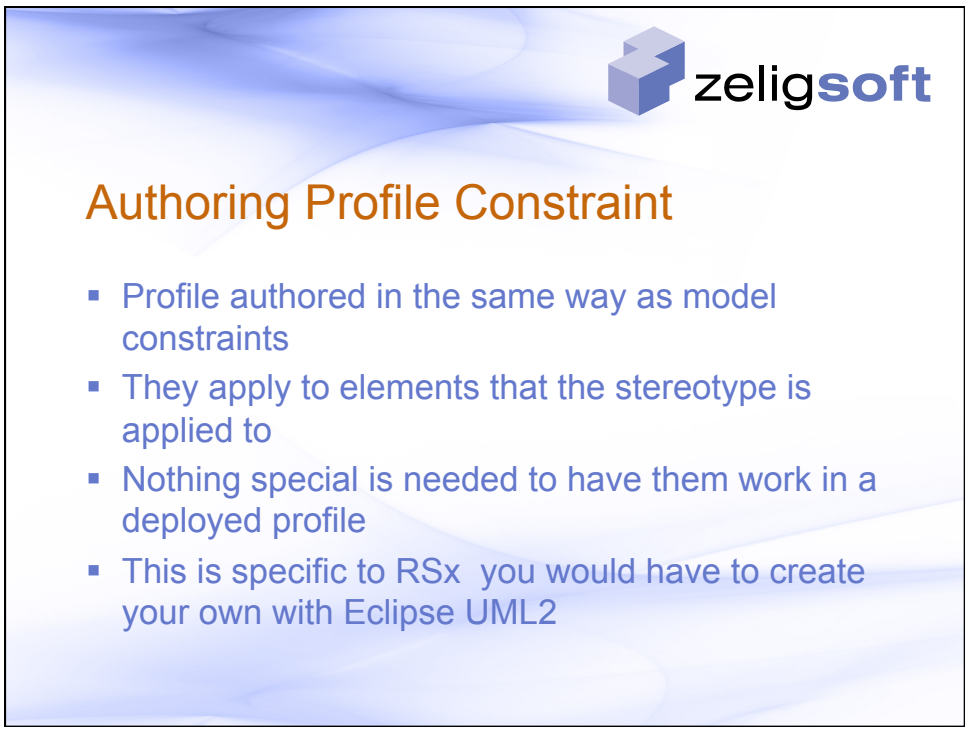
Executing Model Constraint
Batch constraints are evaluated by
Validate in the context menu of the element
Live constraints are evaluated by
Validate in the context menu
i.e. they are all Batch
You will see the results if any
In the problems view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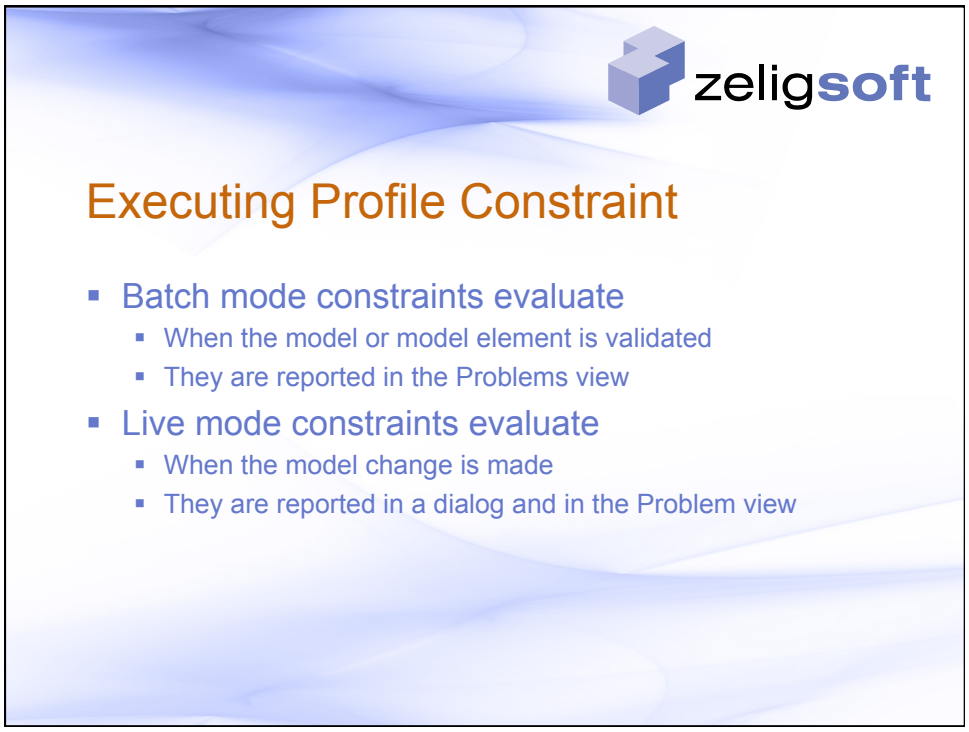
Authoring Profile Constraint
Profile authored in the same way as model constraints
They apply to elements that the stereotype is applied to
Nothing special is needed to have them work in a deployed profile
This is specific to RSx you would have to create your own with Eclipse UML2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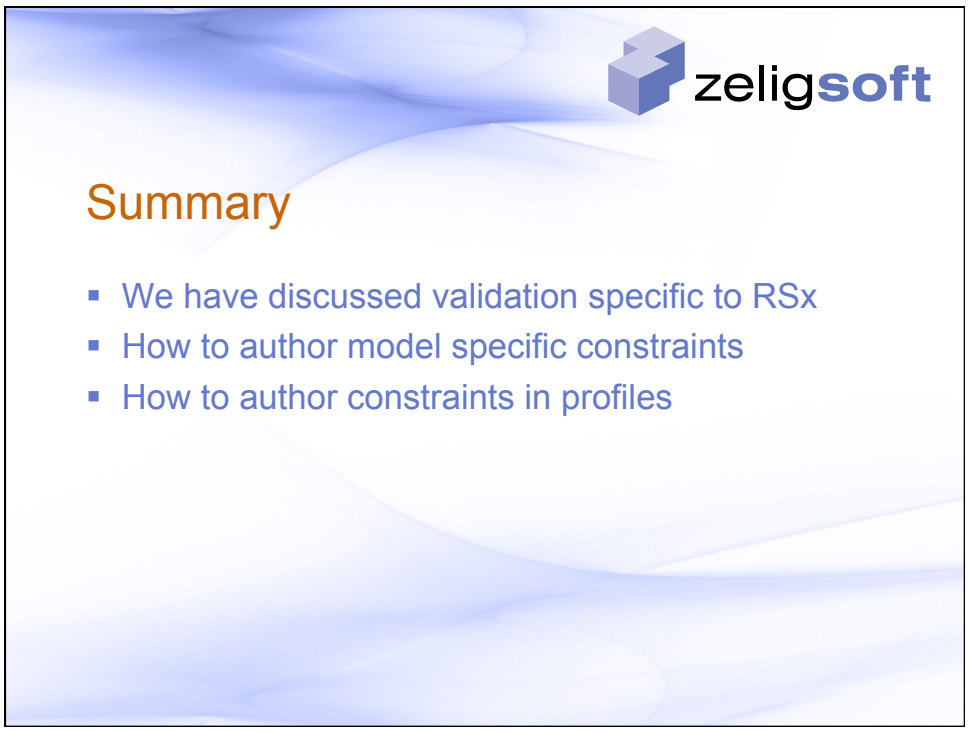
Executing Profile Constraint
Batch mode constraints evaluate
When the model or model element is validated
They are reported in the Problems view
Live mode constraints evaluate
When the model change is made
They are reported in a dialog and in the Problem view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Summary
We have discussed validation specific to RSx
How to author model specific constraints
How to author constraints in profiles

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Questions

Eclipse Transformation Training
Exercise Workbook

1 Plug-in Exercises

1.1 What this exercise is about

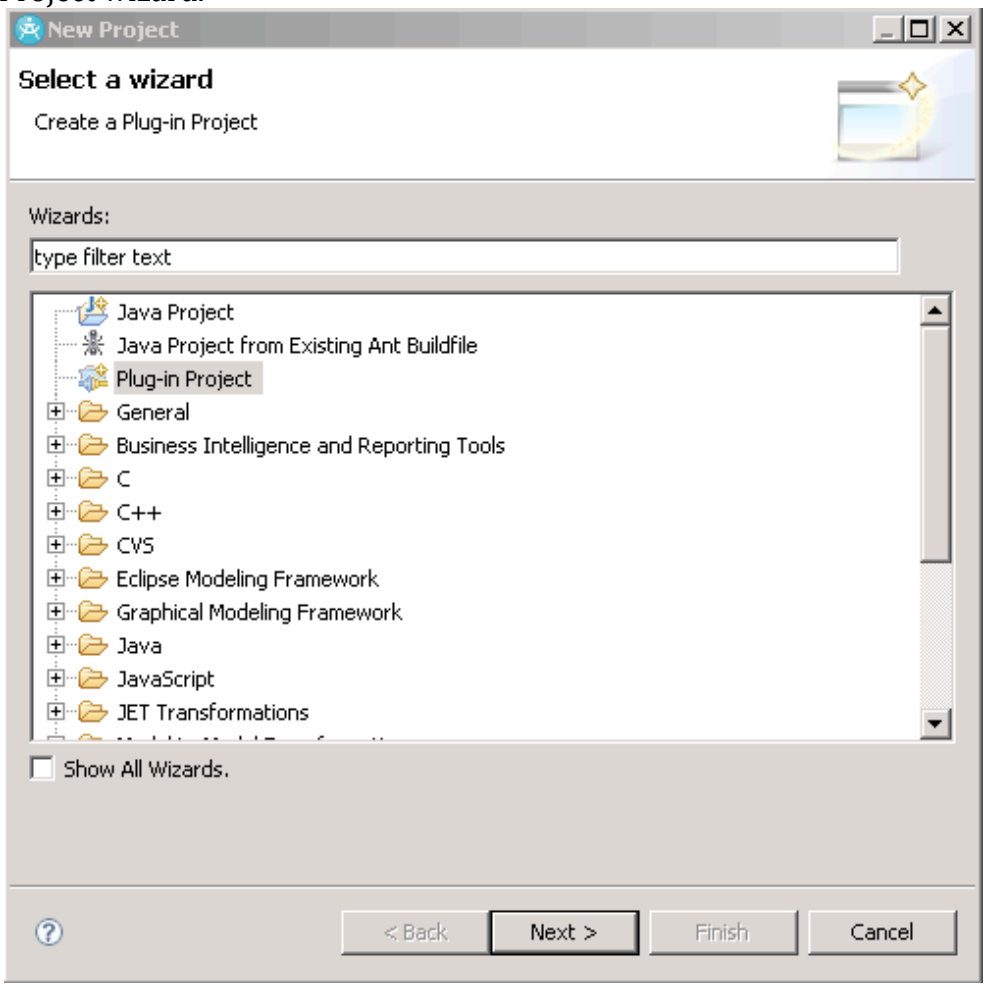
In this exercise you will extend the Workbench

At the end of this exercise you should be able to

- Create Eclipse Plug-in Projects
- Add menus to the Workbench

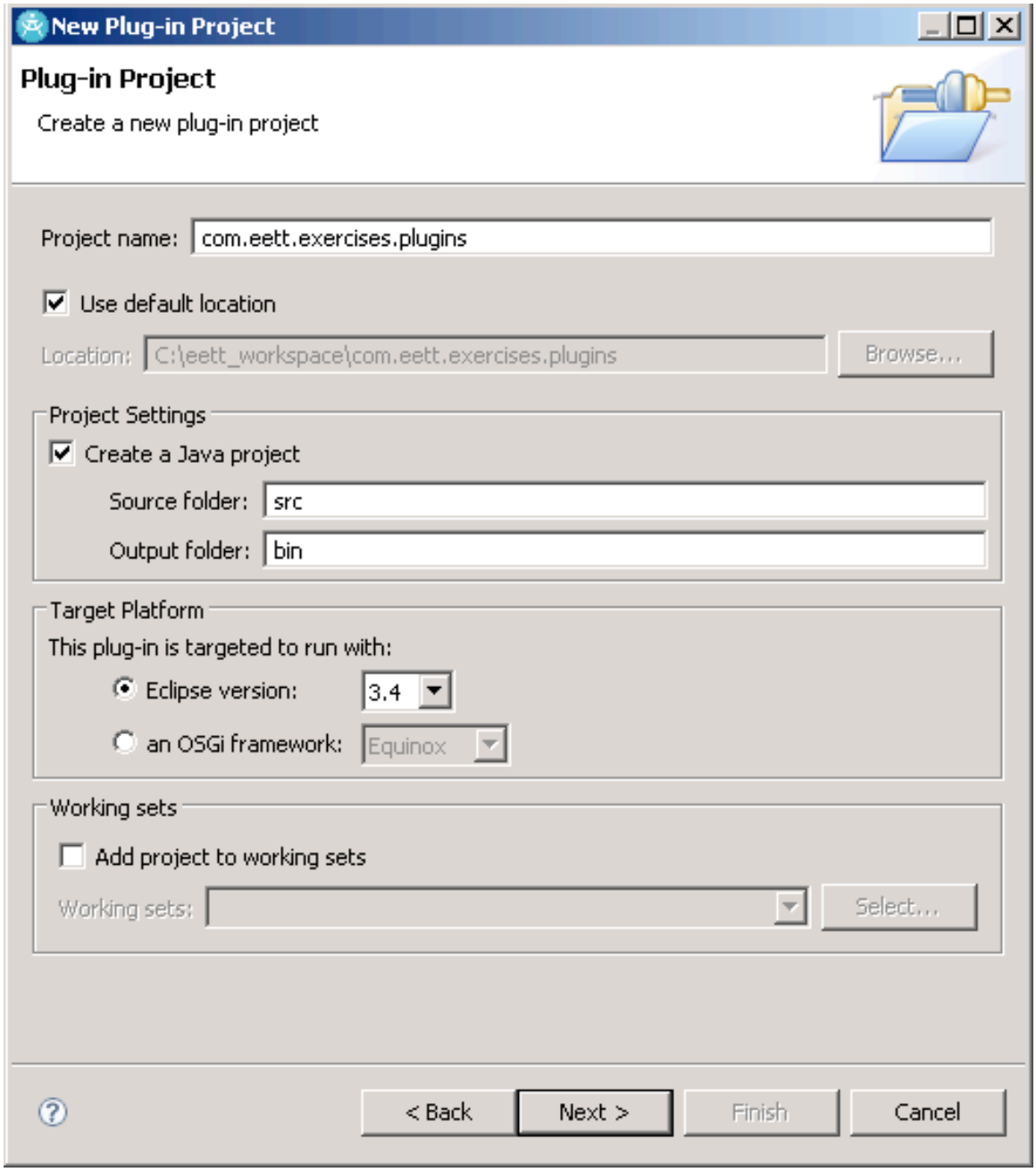
1.2 Create a new project

The first step in creating our plug-in is to create a plug-in project using the Eclipse New Project wizard. We will create an empty Eclipse Plug-in project that contributes to the Workbench UI.
From the File menu New → Project…
Select Plug-in Project from the list of possible projects to create in the New Project wizard.

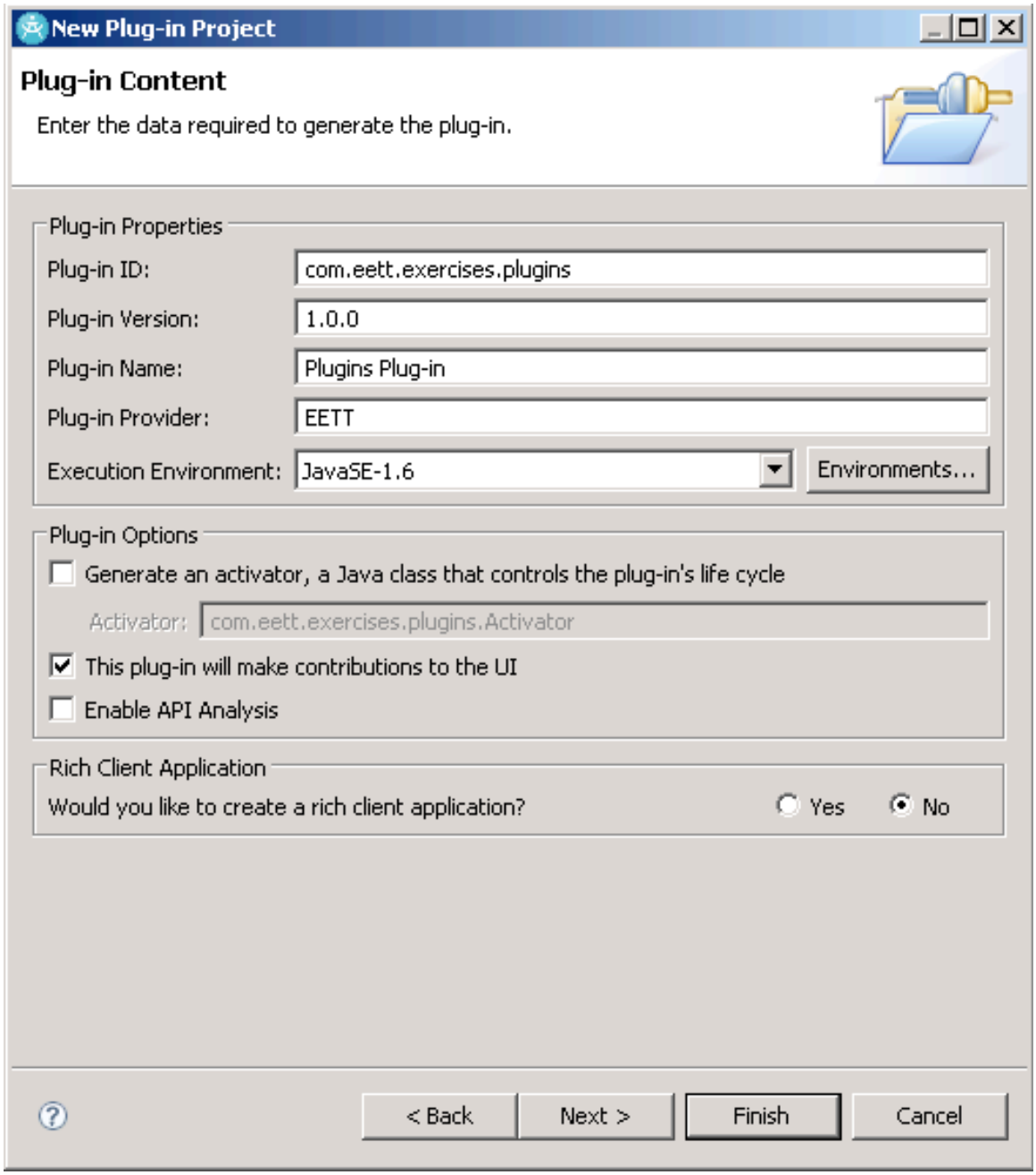


Click the Next button.

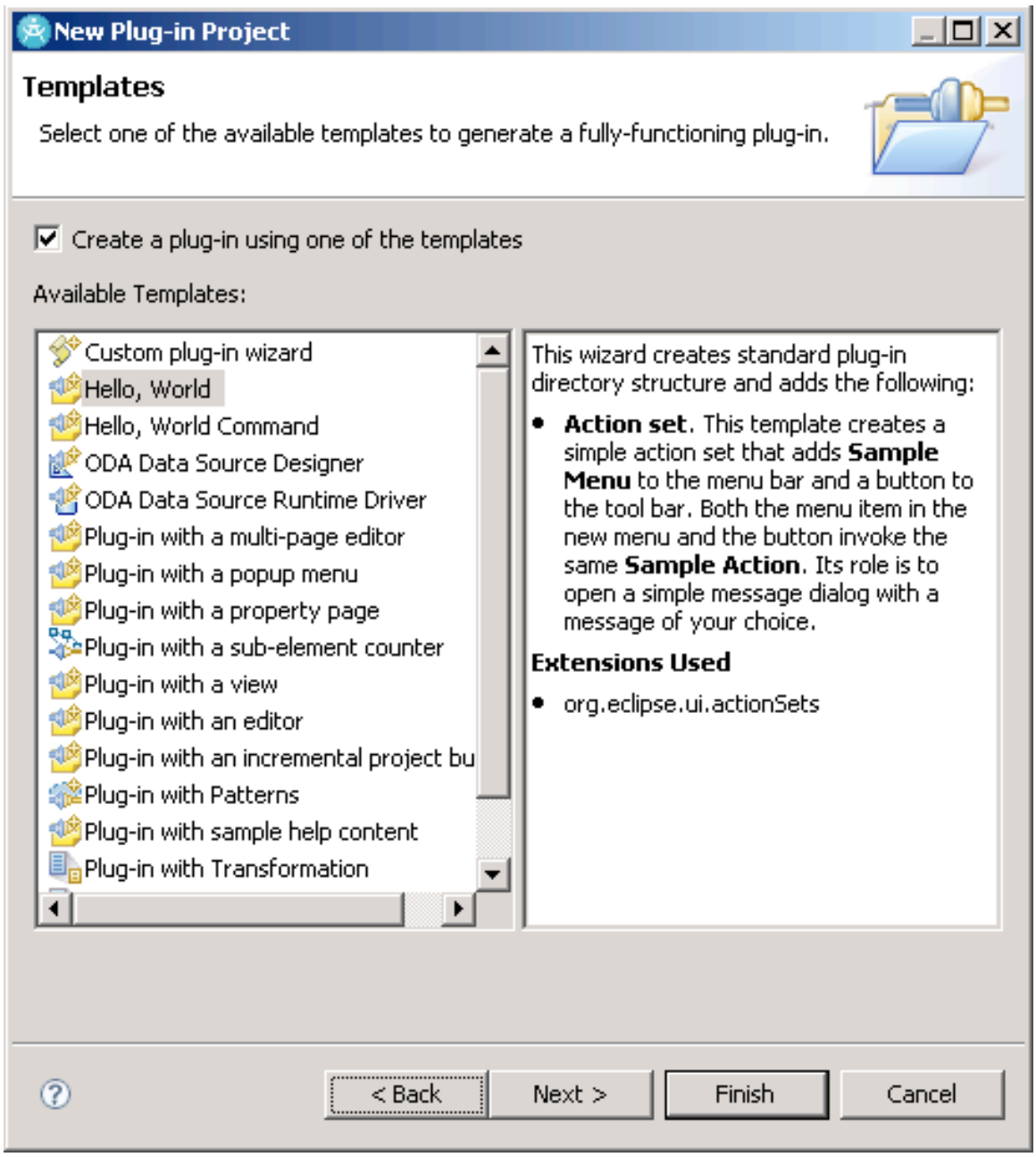
Enter the name of the project; com.eett.exercises.plugins. Keep Use default location and Create a Java project checked. Retain the defaults for the other properties. Click on Next >.



Specify the Plug-in Content. Keep the Plug-in ID, Plug-in Version, Plug-in Provider and Execution Environment defaults. Change the Plug-in Name to EETT Plug-in Exercises. Uncheck Generate an activator and make sure that This plug-in will make contributions to the UI is checked. Click the Next > button.

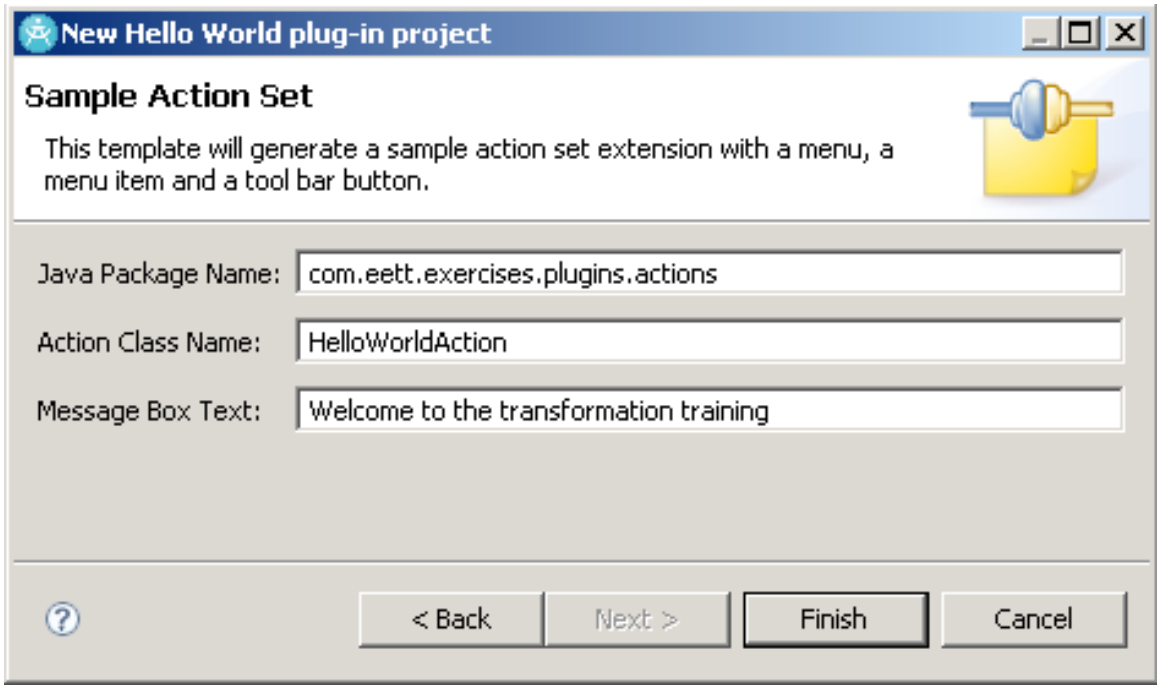


On the Templates page check the 'Create a plug-in using one of the templates' and select the 'Hello, World' option. Click Next >.



By using a Template most of the code necessary to create a menu and an Action to handle selecting the menu is generated for you.

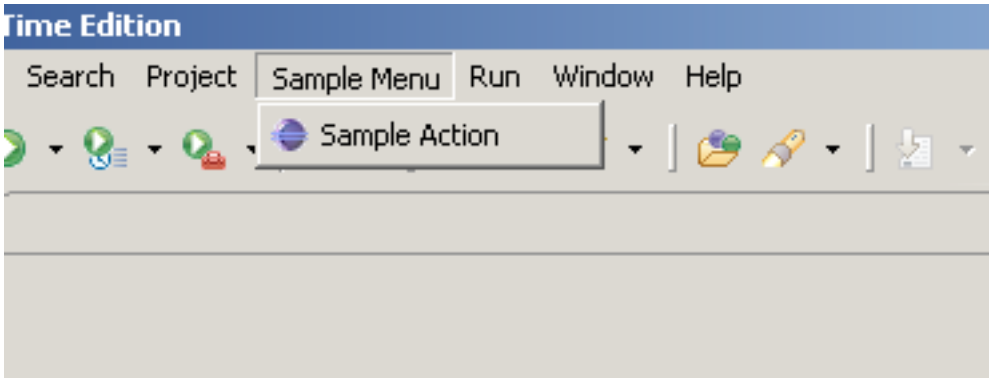
In the Sample Action Set page you can configure the code that will be generated. Change the Action Class Name to HelloWorldAction and the Message Box Text to Welcome to the transformation training. Click Finish.

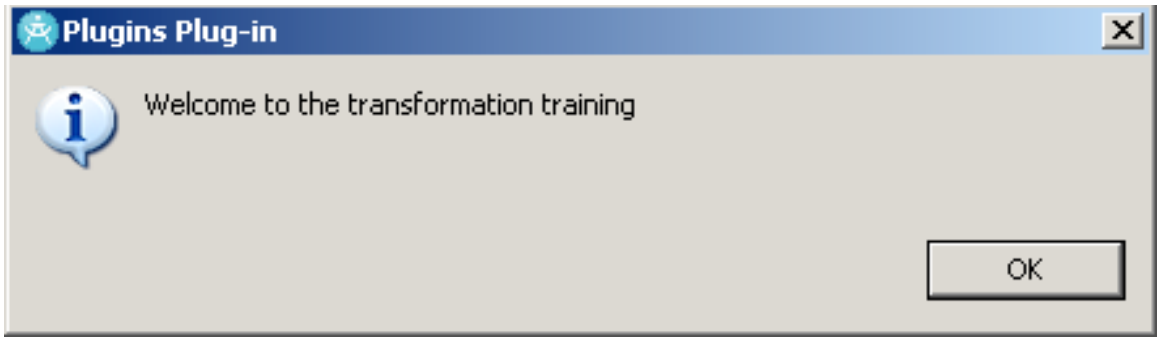


When prompted to switch to the Plug-in Development perspective click Yes.

1.3 Test the plug-in

At this point we can launch a Runtime Workbench and see our plug-in in action. To view the default that is generated select Run As → Eclipse Application from the project's context menu.



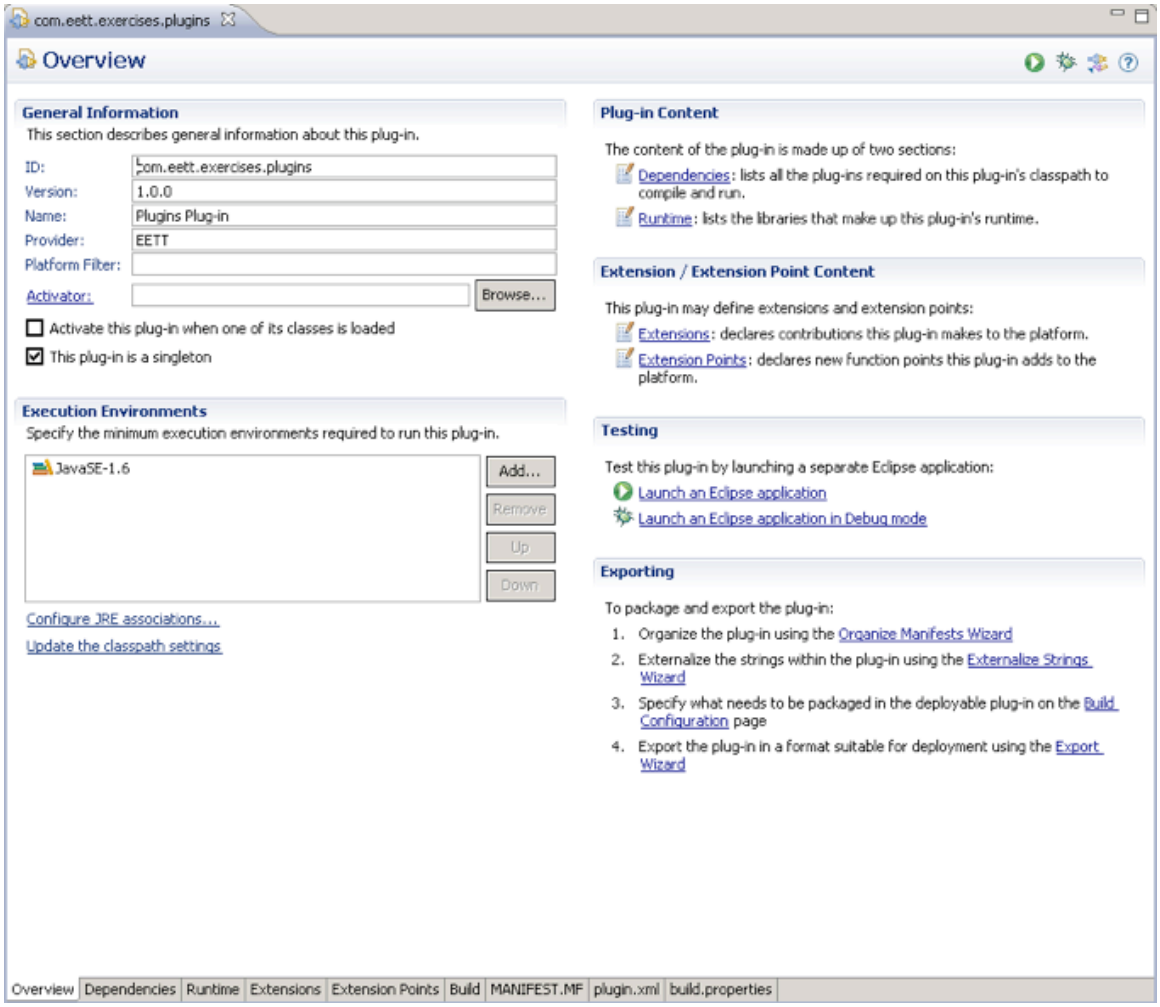


This is an Eclipse version of the classic Hello World application. We will explore in more detail and augment the default that was created for us.

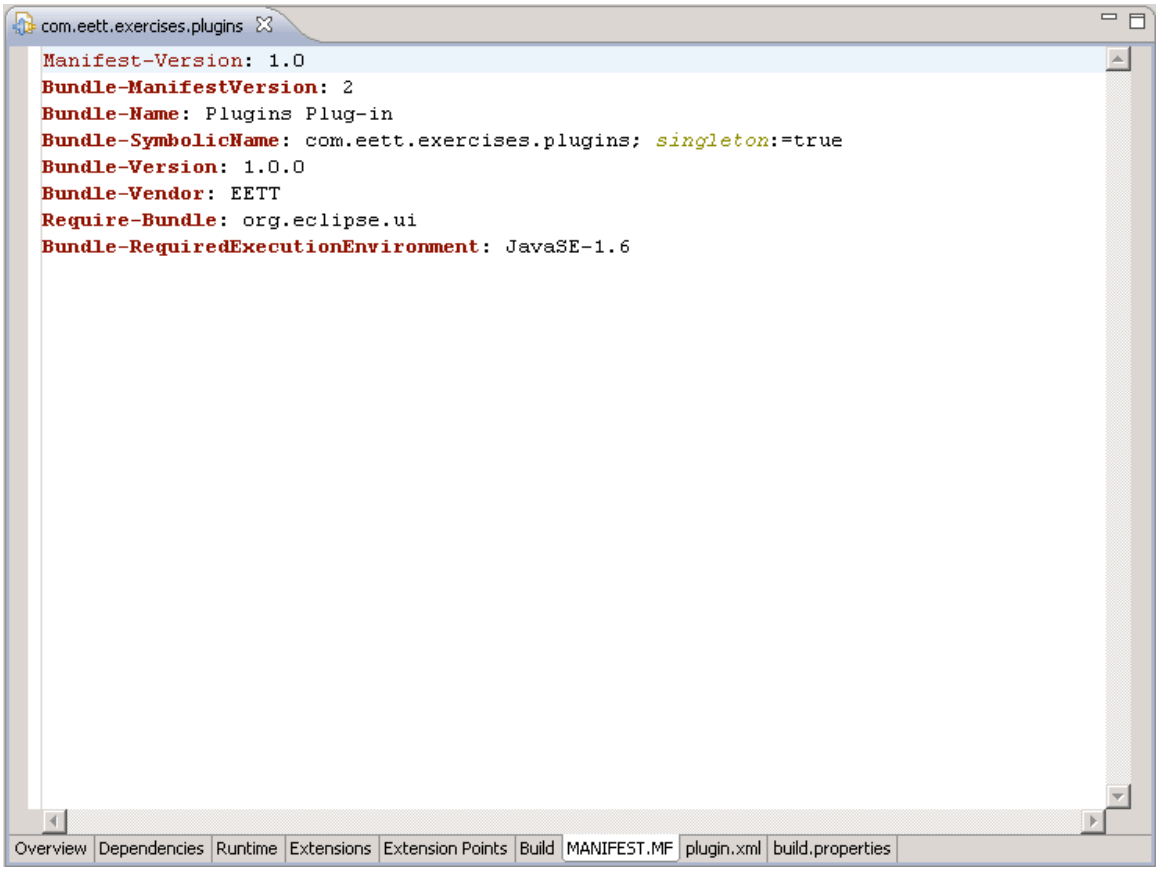
1.4 Define the plug-in manifest files

The project wizard that we used in the previous steps created the plug-in manifest files for us. The plugin.xml contains our extensions to the Eclipse workbench and META-INF/MANIFEST.MF describes the plug-in and its dependencies.

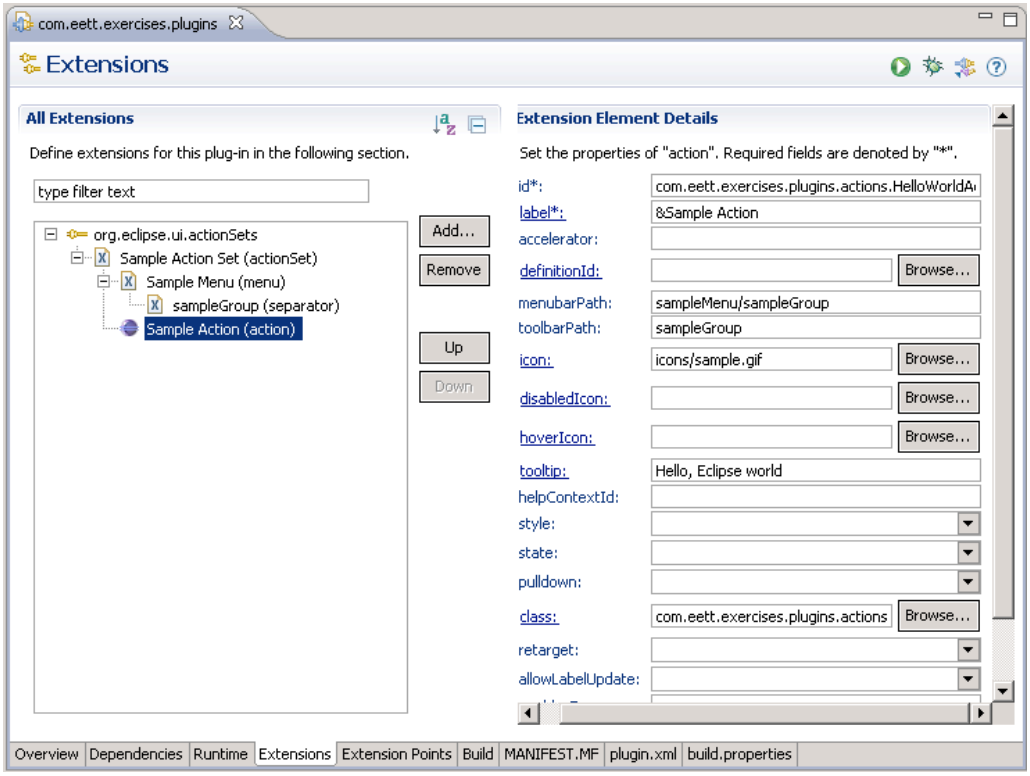
Open the MANIFEST.MF file in the Plug-in Manifest Editor and explore the values using the Overview, Dependencies and Runtime pages.



You can also change the MANIFEST.MF manually using the MANIFEST.MF page in the editor. We do not need to change this file at this point.



Open the plugin.xml using the Plug-in Manifest Editor. The current file should look like the following. We will change some of these values in order to customize the defaults that were generated by the wizard.

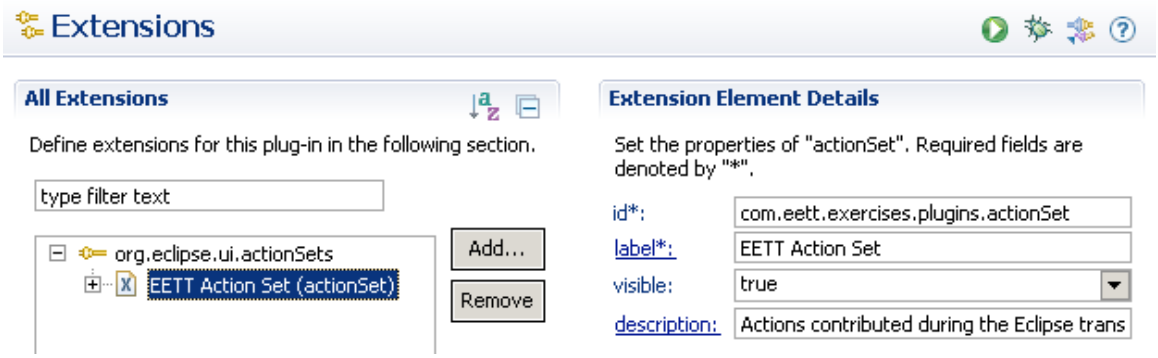


(xml content on next page)

```
<plugin>
  <extension
    point="org.eclipse.ui.actionSets">
    <actionSet
      label="Sample Action Set"
      visible="true"
      id="com.eett.exercises.plugins.actionSet">
      <menu
        label="Sample &amp;Menu"
        id="sampleMenu">
        <separator
          name="sampleGroup">
        </separator>
      </menu>
      <action
        label="&amp;Sample Action"
        icon="icons/sample.gif"
        class="com.eett.exercises.plugins.actions.HelloWorldAction"
        tooltip="Hello, Eclipse world"
        menubarPath="sampleMenu/sampleGroup"
        toolbarPath="sampleGroup"
        id="com.eett.exercises.plugins.actions.HelloWorldAction">
      </action>
    </actionSet>
  </extension>
</plugin>
```

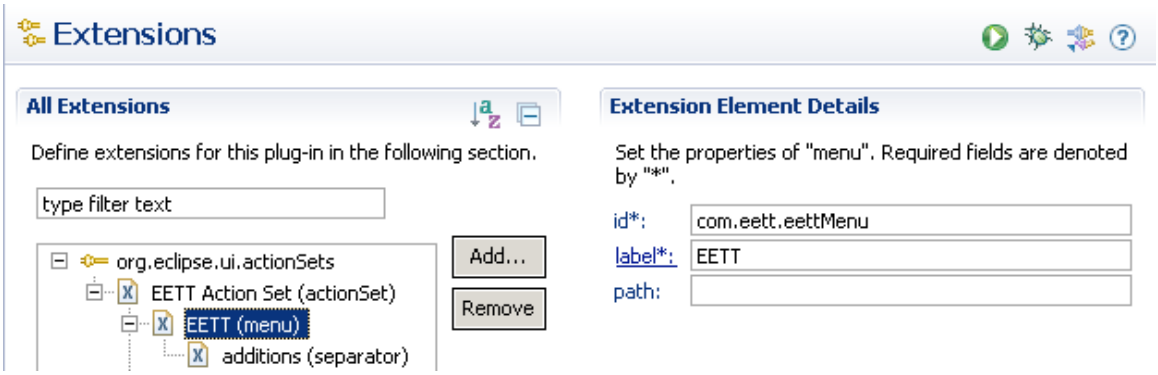
When we ran the plug-in that was generated the menu item names were not very descriptive or customized. We will change the names of the menus from Sample… to something more specific to our exercises. We will reuse the main menu item that is contributed to the workbench so we need to ensure that its name is applicable and that its id is intuitive.

Start by changing the label of the actionSet to EETT Action Set, which is the label used by the Workbench to represent this action set to the user. We will also set the description field to 'Actions contributed during the Eclipse transformation training'. This change will show up in the perspective configuration where you can show and hide action sets.

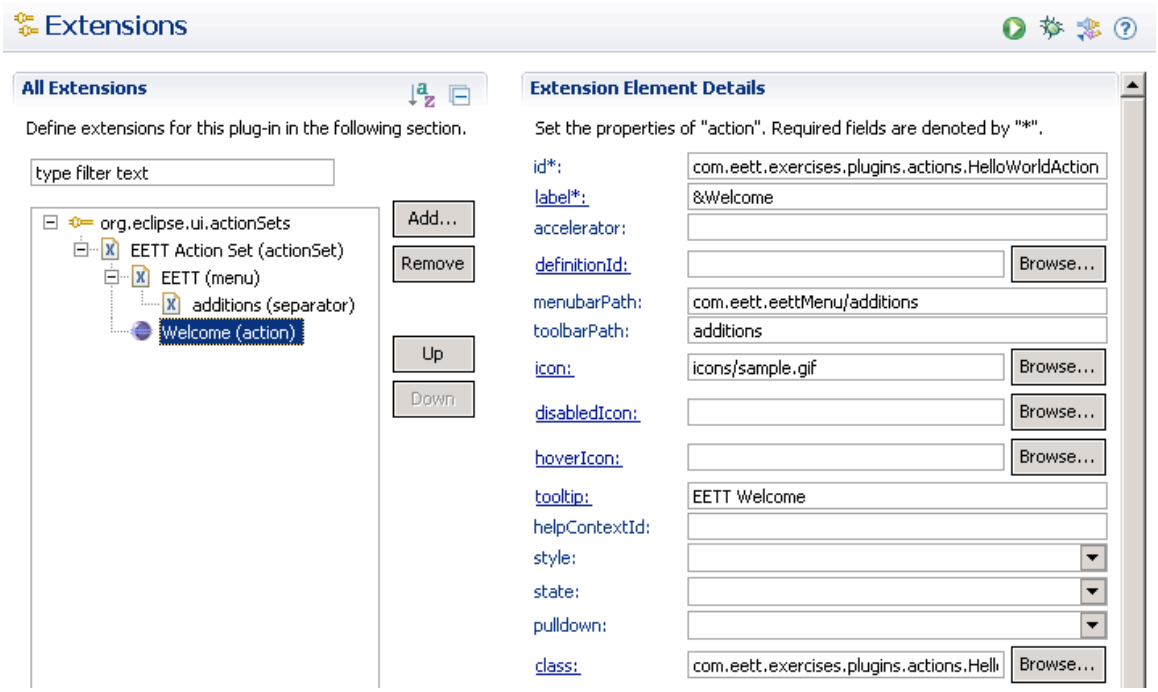


Change the menu label to EETT, which will be the label used in the main menu of the workbench. Also, change the id of the menu to com.eett.eettMenu, this id is used to refer to the menu to add actions.

Change the menu's separator to have the name additions rather than sampleGroup. This separator is used as part of the path to add actions to the EETT menu.

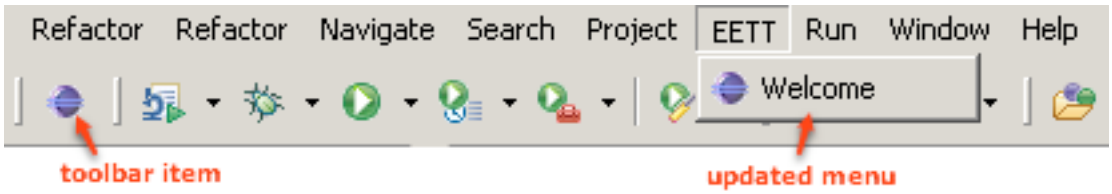


We can now update the action to reflect the changes we have made to the menu and action set. We will start by changing the label to Welcome to better reflect what the action does. In the previous steps we changed the id of the menu and the name of its seperator so we have to update the path menubarPath to reflect this; change it to com.eett.eettMenu/additions. We can also change the tooltip to EETT Welcome.

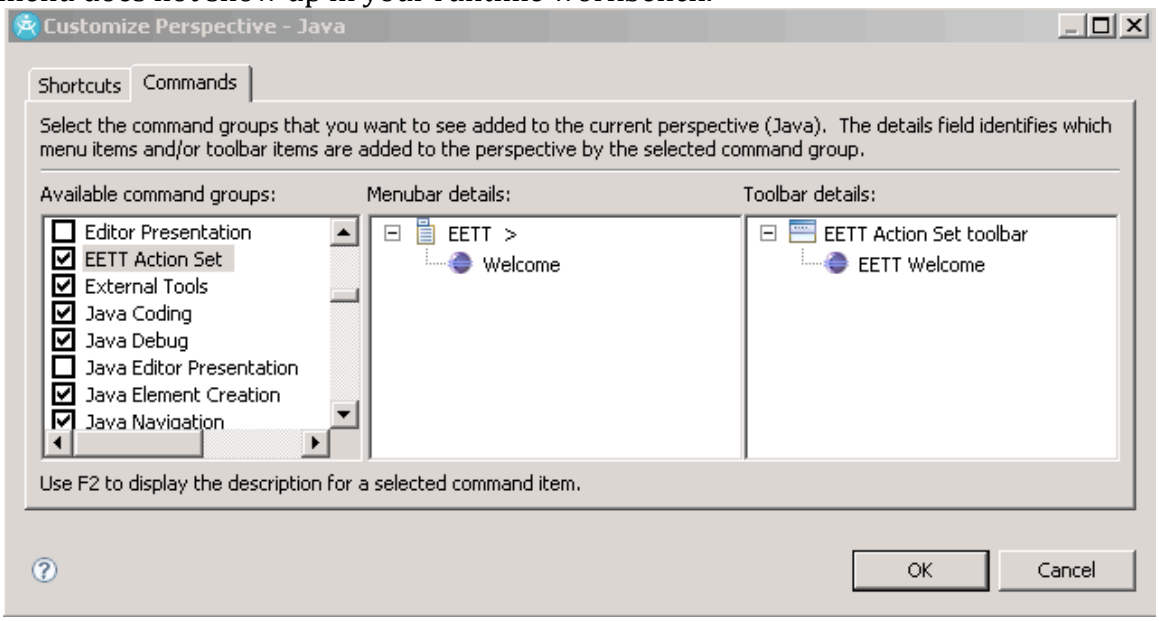


The plugin.xml file should now resemble

```
<plugin>
  <extension
    point="org.eclipse.ui.actionSets">
    <actionSet
      label="EETT Action Set"
      visible="true"
      id="com.eett.exercises.plugins.actionSet">
      <menu
        label="EETT"
        id="com.eett.eettMenu">
        <separator
          name="additions">
        </separator>
      </menu>
      <action
        label="&amp;Welcome"
        icon="icons/sample.gif"
        class="com.eett.exercises.plugins.actions.HelloWorldAction"
        tooltip="EETT Welcome"
        menubarPath="com.eett.eettMenu/additions"
        toolbarPath="additions"
        id="com.eett.exercises.plugins.actions.HelloWorldAction">
      </action>
    </actionSet>
  </extension>
</plugin>
```



To view our action set name changes we can open the Customize Perspective dialog; Window → Customize Perspective… This is also a good place to look if the menu does not show up in your runtime workbench.



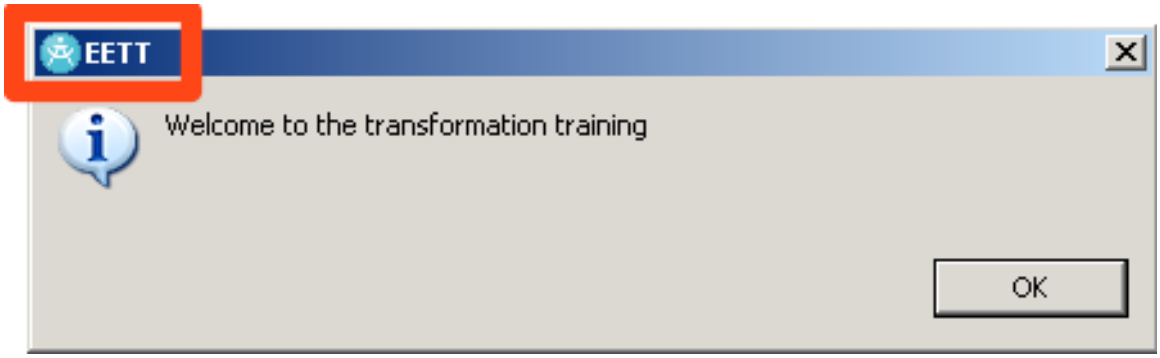
1.5 Implement the action delegate

This part of the exercise will modify the default action delegate that was generated by the wizard. Switch to the Java perspective and open the HelloWorldAction.java file. The code is documented, take a few minutes to familiarize yourself with it.

We are going to the change the title for the dialog box. In the run method change the second parameter of MessageDialog.openInformation to "EETT". *Note that it is best practice to externalize strings such as this one so that they can be localized.* Your run method should now resemble.

```
public void run(IAction action) {
      MessageDialog.openInformation(
            window.getShell(),
            "EETT",
            "Welcome to the transformation training");
}
```

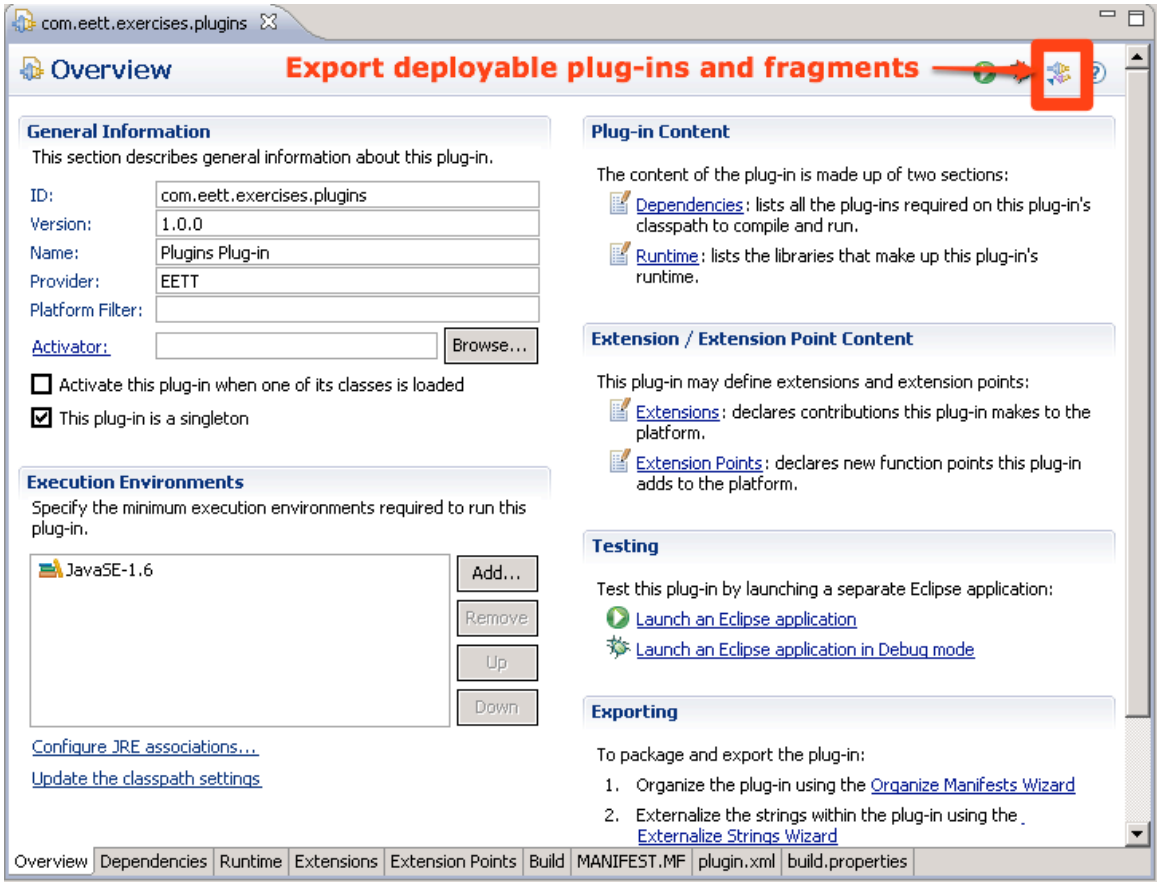
Save your changes and launch the runtime workbench to ensure that your changes were made. It should now look like.



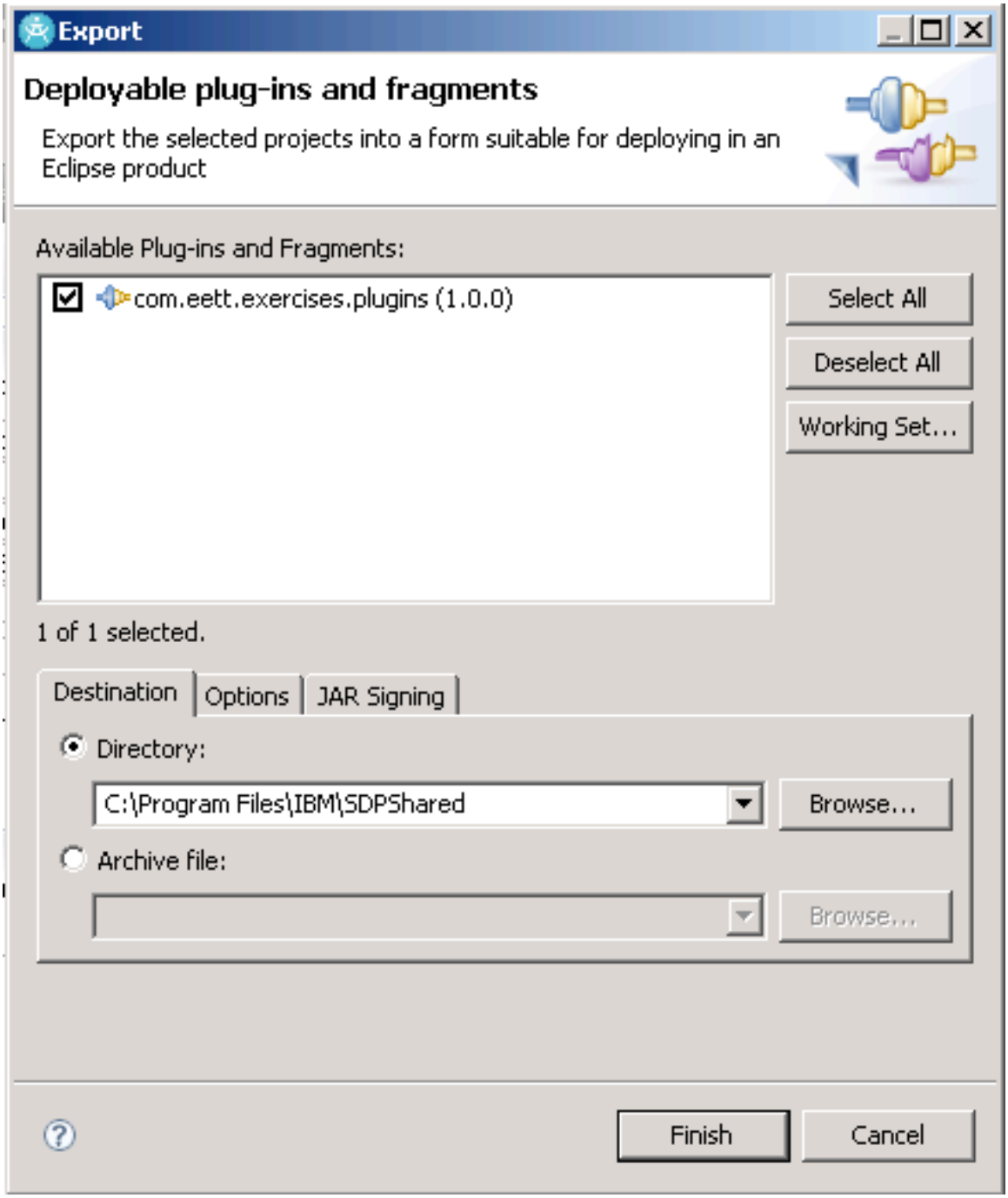
1.6 Publish the plug-in

We now have a plug-in and we can publish it to our installation so that it is available without running the workbench.

Open the Plug-in Manifest Editor for our plug-in and switch to the Overview page. In the top right-hand corner is a button to export the plug-in. Click on the button.



In the dialog make sure your plug-in is selected in the list of Available Plug-ins and specify Destination Directory as a dropins directory in your Eclipse install. With RSA-RTE this will likely be SDP directory of your install. Leave the other settings to their defaults.



Click the Finish button and restart your workbench. When the workbench restarts it will have the EETT menu just like in the runtime workbench. Test to make sure that it behaves the same.

Through out the course we will add additional actions to the EETT menu.

2 Eclipse Modeling Framework Exercises

In this exercise a metamodel for the structural part of ROOM will be developed in order to gain a better understanding of EMF. The exercise will start by creating an Ecore model of the ROOM language. This model is used to create dynamic instances and to generate the code for the metamodel and a default tree based editor. There will be activities that show how to work with the generated code in order to implement the derived attributes, implement operations and override code that is generated by EMF.

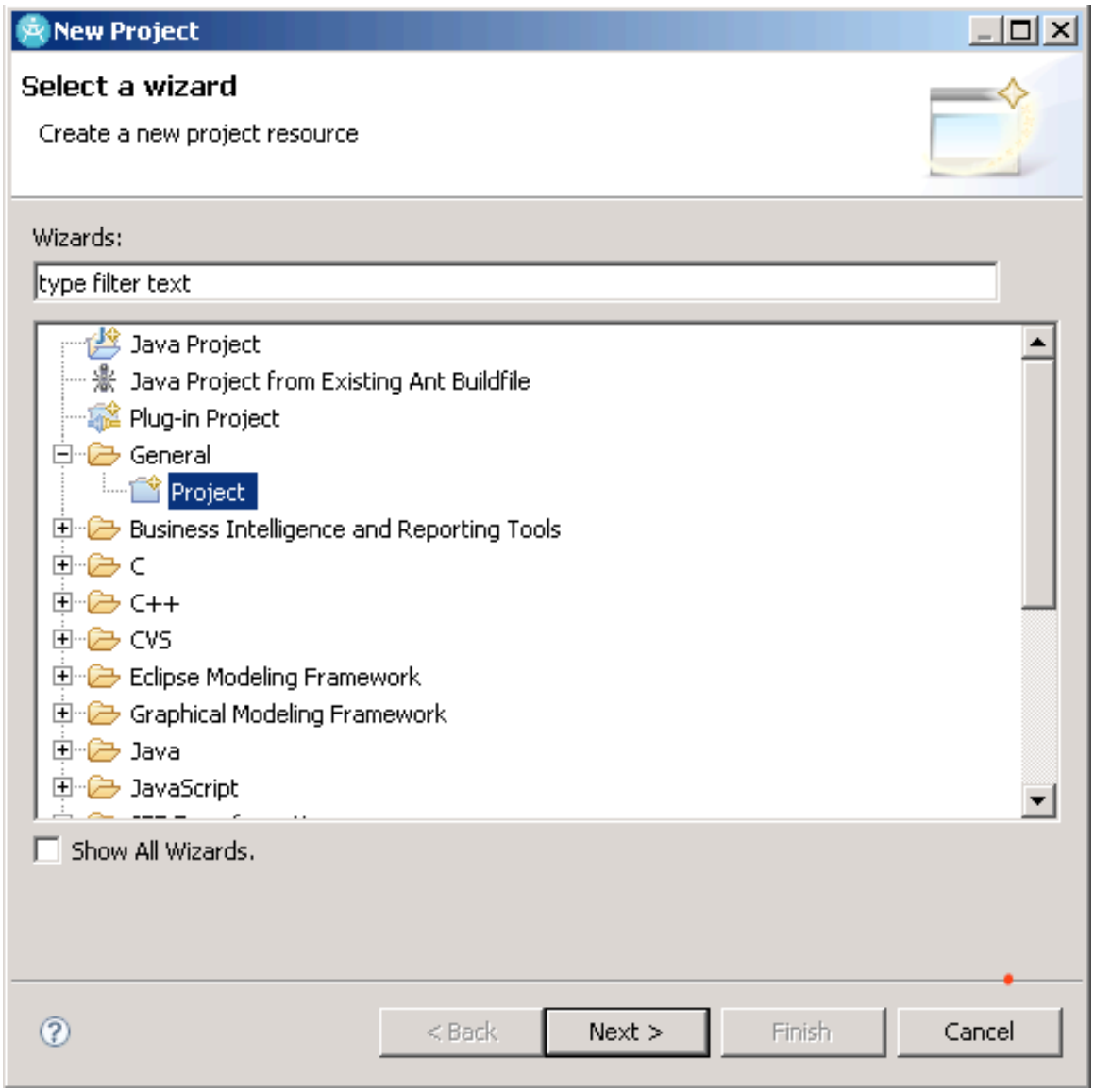
The last two activities of the exercise will practice working with transactions and querying a model.

2.1 Building an Ecore Model

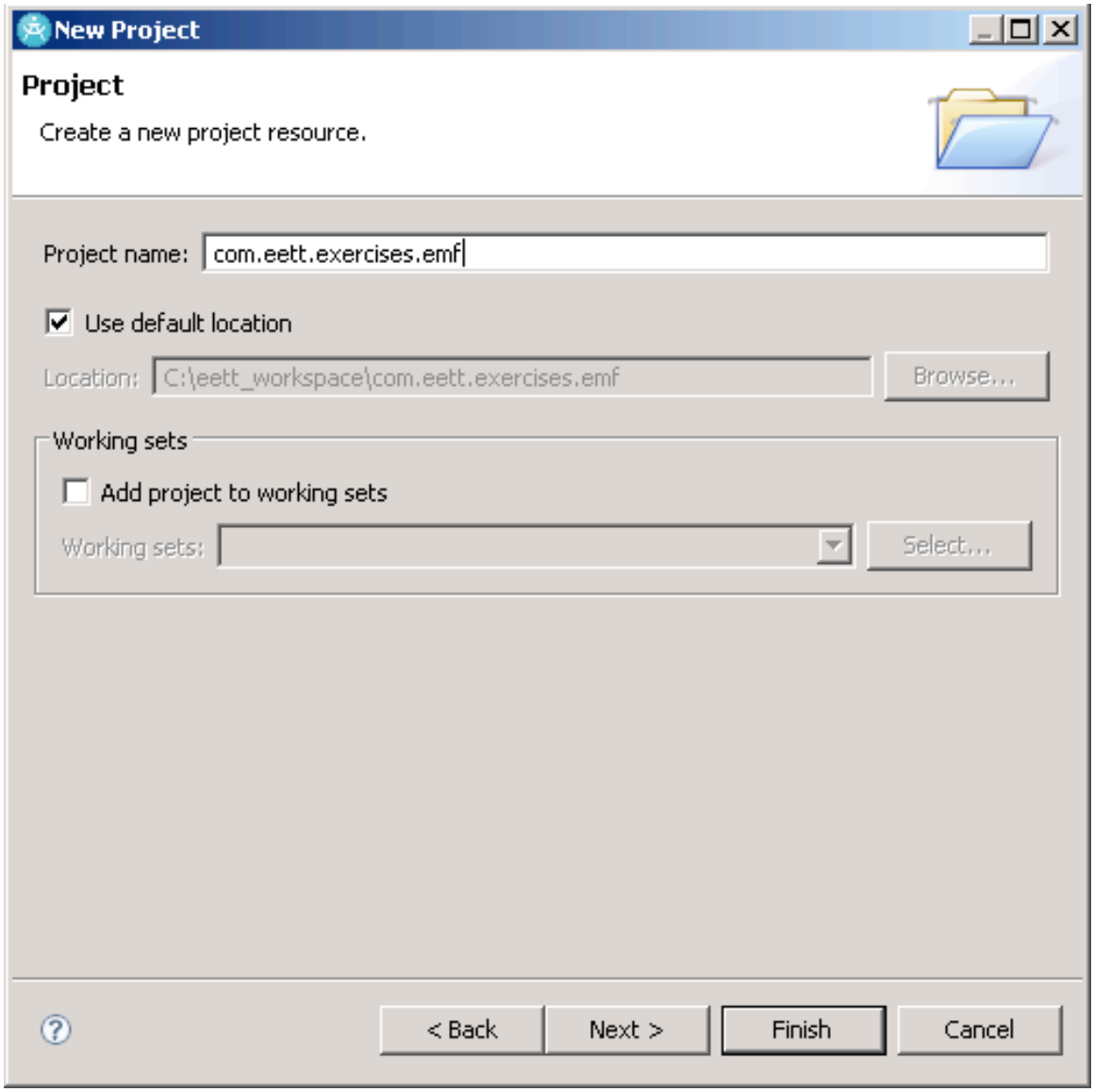
Create a new project basic project.

From the main menu select File → New → Project…

In the New Project Wizard select Project under the General group, and click the Next > button.



Provide a Project Name, com.eett.exercises.emf and click the Finish button

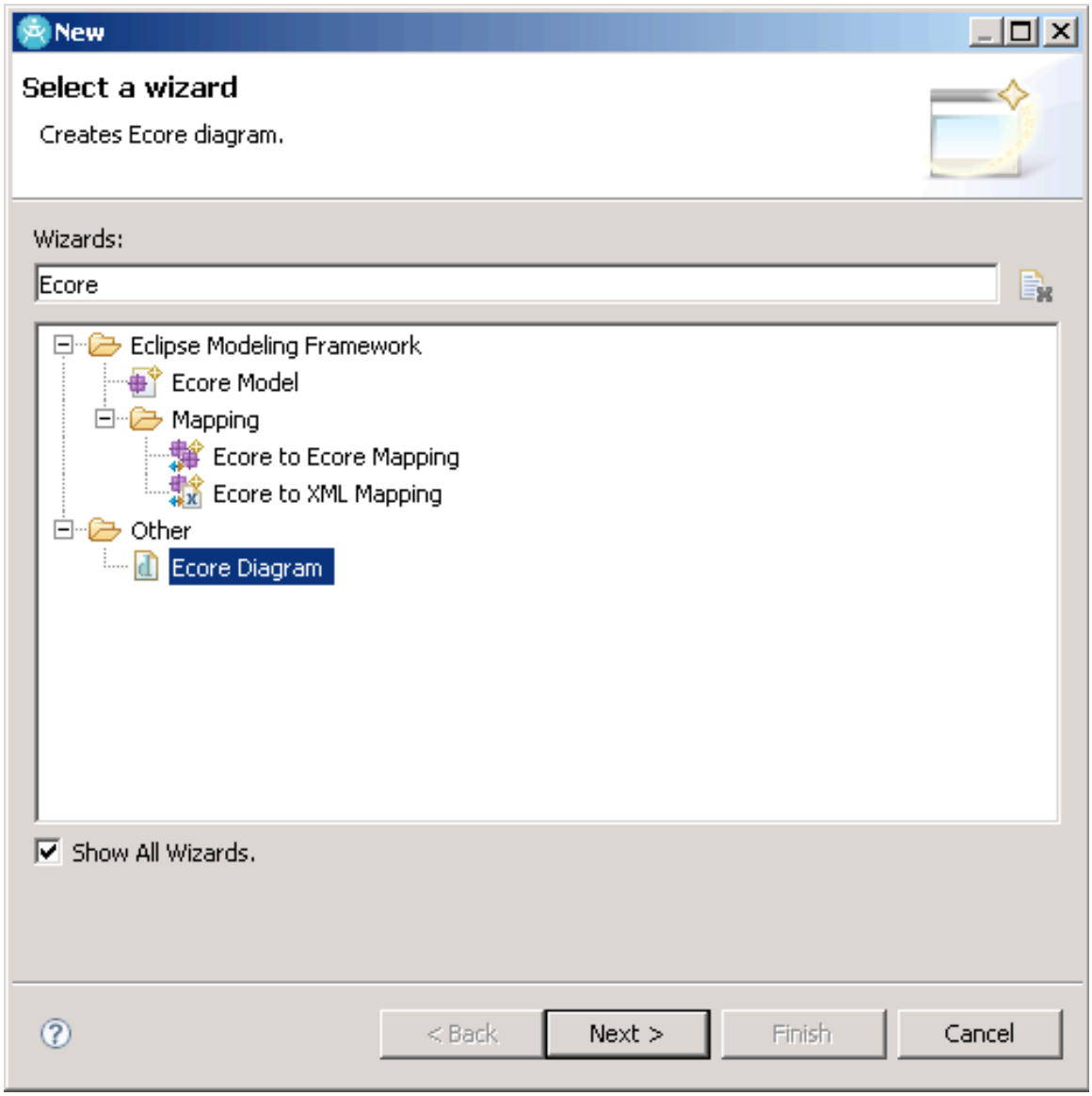


Create a new EMF model.

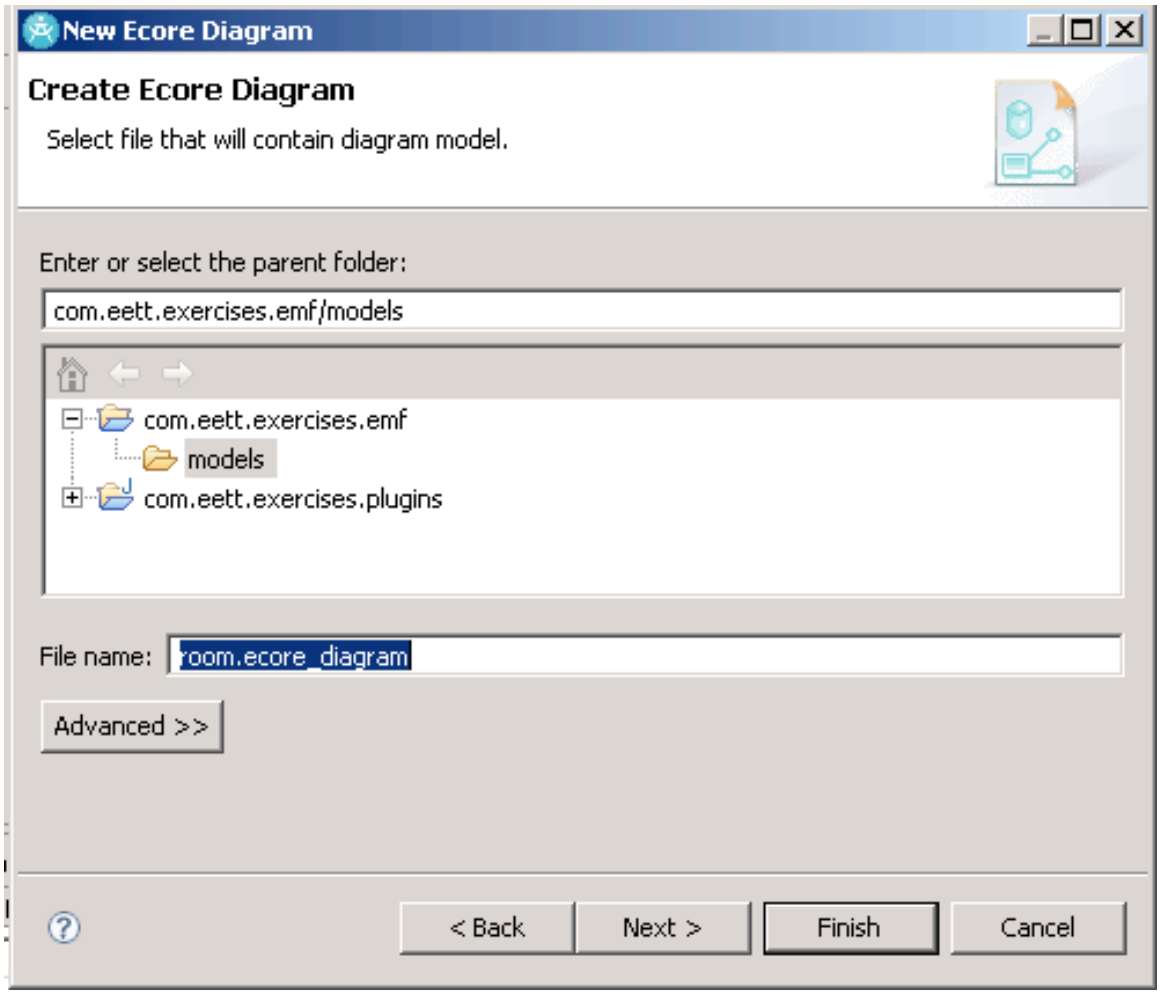
Add a models folder to the com.eett.exercises.emf project, to store our model artifacts

Select the models folder and choose File → New → Other…

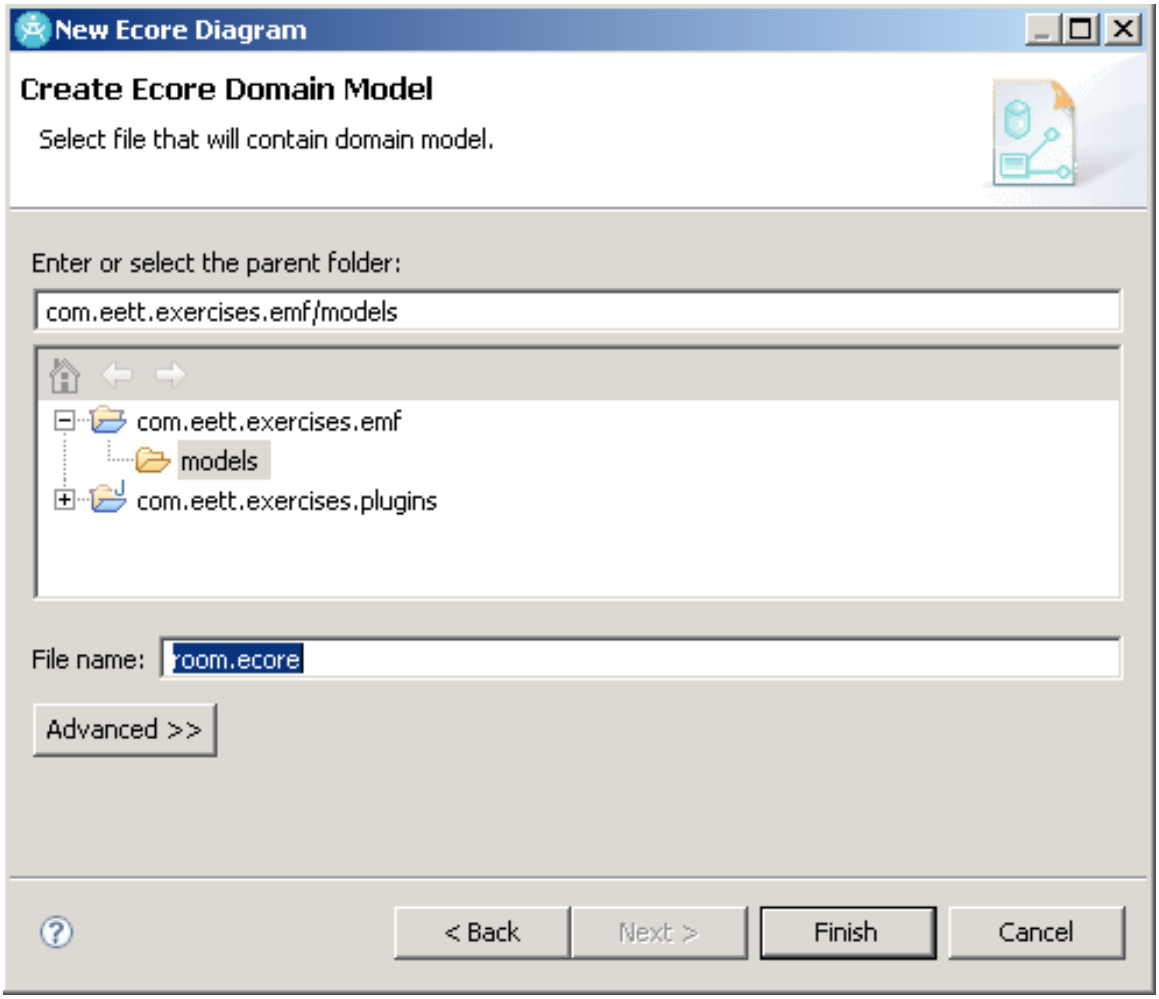
In the New wizard select Ecore Diagram from Other (you may have to check Show All Wizards) and click the Next > button



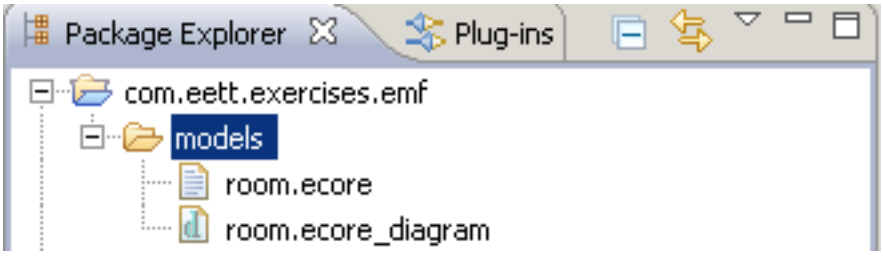
Set the name of the Ecore Diagram to room.ecore_diagram and click the Next > button



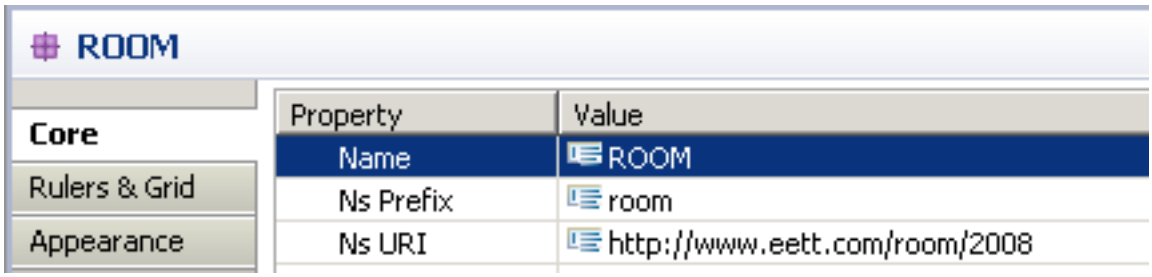
Set the name of the Ecore model to room.ecore and click the Finish button



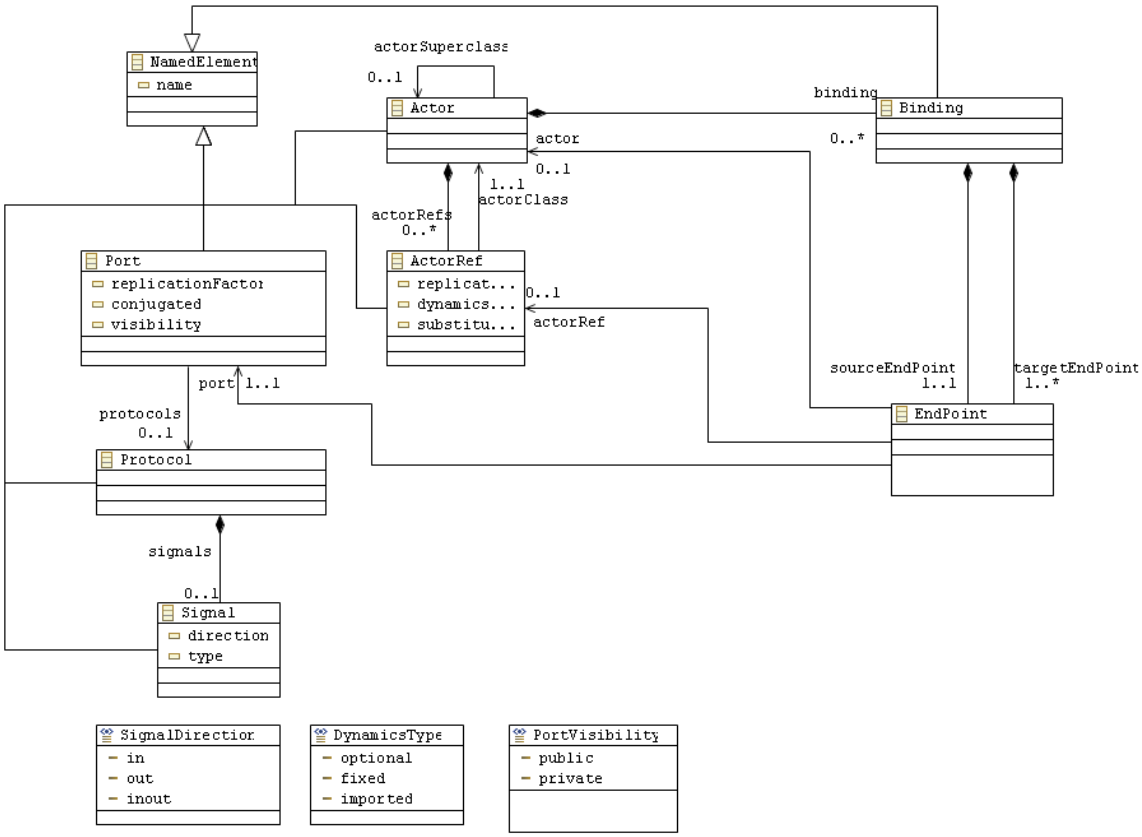
Your project should now look like



Open the Ecore diagram and set the properties in the property grid to the following, this configures the properties of the root ePackage. To access the properties right-click in the diagram editor and select Show Properties View.



In the diagram editor build a model that looks like the following



NamedElement (Abstract EClass)

Attributes

Name	Type	Lower bound	Upper bound
name	EString	0	1

References

Name	Type	Containment	Opposite	Lower bound	Upper bound

Actor (EClass) extends NamedElement

Attributes

Name	Type	Lower bound	Upper bound

References

Name	Type	Containment	Opposite	Lower bound	Upper bound
actorSuperClass	Actor	false		0	1
bindings	Binding	true	actor	0	-1
actorRefs	ActorRef	true	container	0	-1
ports	Port	true		0	-1

ActorRef (EClass)

Attributes

Name	Type	Lower bound	Upper bound	Default
replicationFactor	EInt	0	1	
dynamicsType	DynamicsType	0	1	fixed
substitutable	EBoolean	0	1	false

References

Name	Type	Containment	Opposite	Lower bound	Upper bound
actorClass	Actor	false		1	1
container	Actor	false	actorRefs	1	1

Port (EClass)

Attributes

Name	Type	Lower bound	Upper bound	Default
replicationFactor	EInt	0	1	1
conjugated	EBoolean	0	1	false
visibility	PortVisibility	0	1	public

References

Name	Type	Containment	Opposite	Lower bound	Upper bound
protocol	Protocol	false		0	1

Protocol (EClass)

Attributes

Name	Type	Lower bound	Upper bound

References

Name	Type	Containment	Opposite	Lower bound	Upper bound
signals	Signal	true		0	-1

Signal (EClass)

Attributes

Name	Type	Lower bound	Upper bound	Default
direction	SignalDirection	0	1	in
type	EString	0	1	

References

Name	Type	Containment	Opposite	Lower bound	Upper bound

SignalDirection (EEnum)

Name	Value
IN	0
OUT	1
INOUT	2

DynamicsType (EEnum)

Name	Type
optional	0
fixed	1
imported	2

PortVisibility(EEnum)

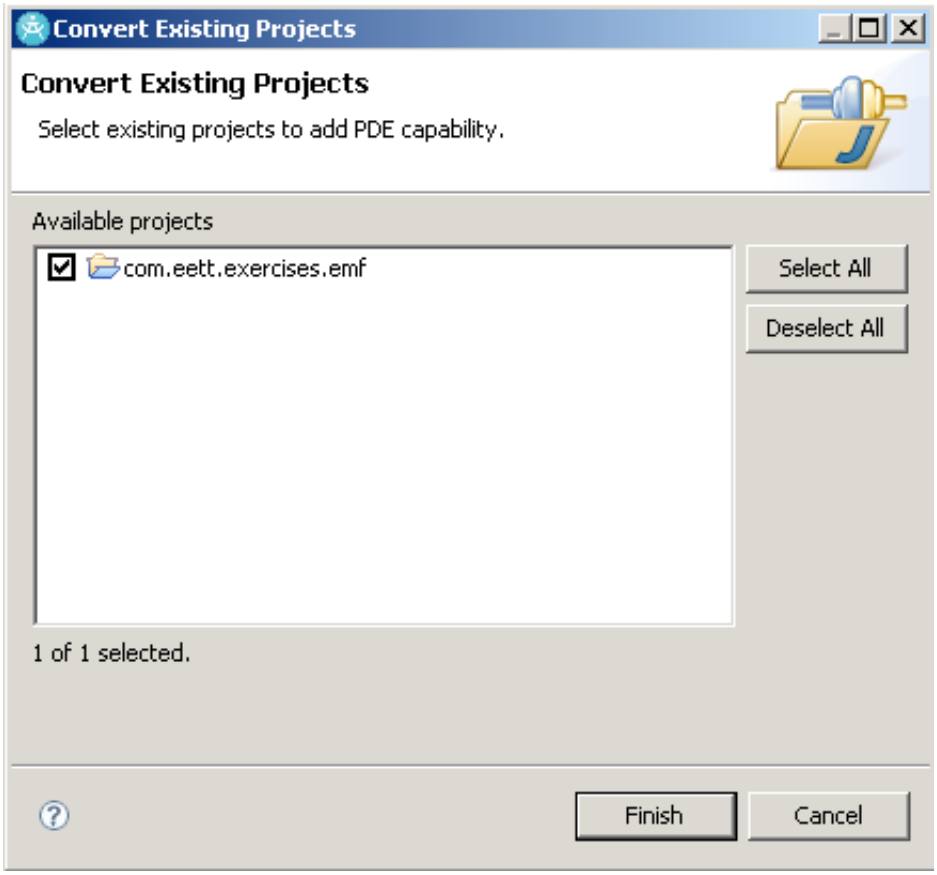
Name	Type
public	0
private	1

When finished creating the model validate it to ensure that there are no errors. To validate select the root package and Sample Ecore Editor → Validate from the main menu.

We have built a metamodel for a subset of the ROOM language, we can now look at creating the generator model and creating models using the metamodel.

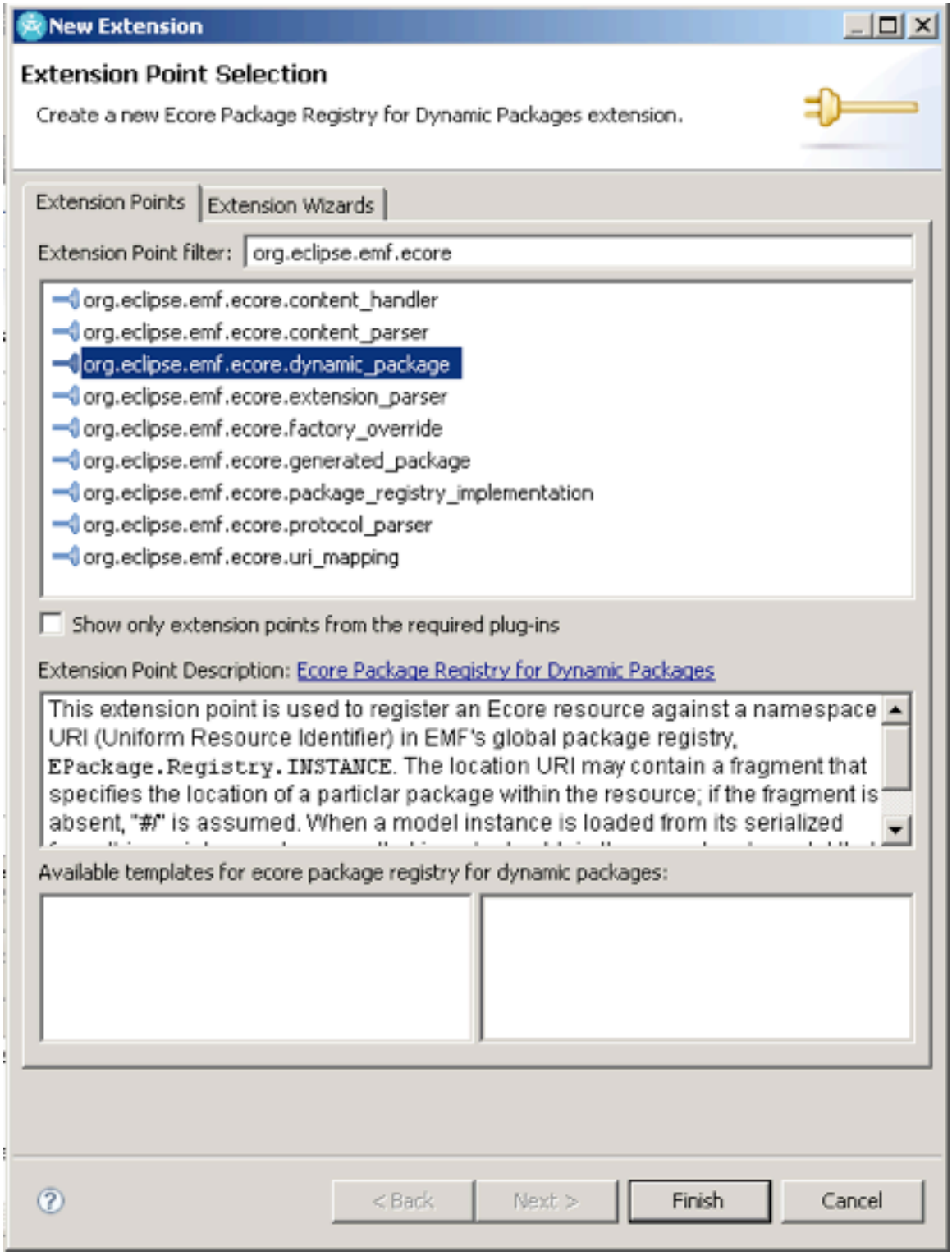
Publish the Model so that it can be used dynamically

We will first convert our com.eett.exercises.emf project to a plugin project. Select the project and choose PDE Tools → Convert Projects to Plug-in Projects… Make sure that com.eett.exercises.emf is checked and click Finish

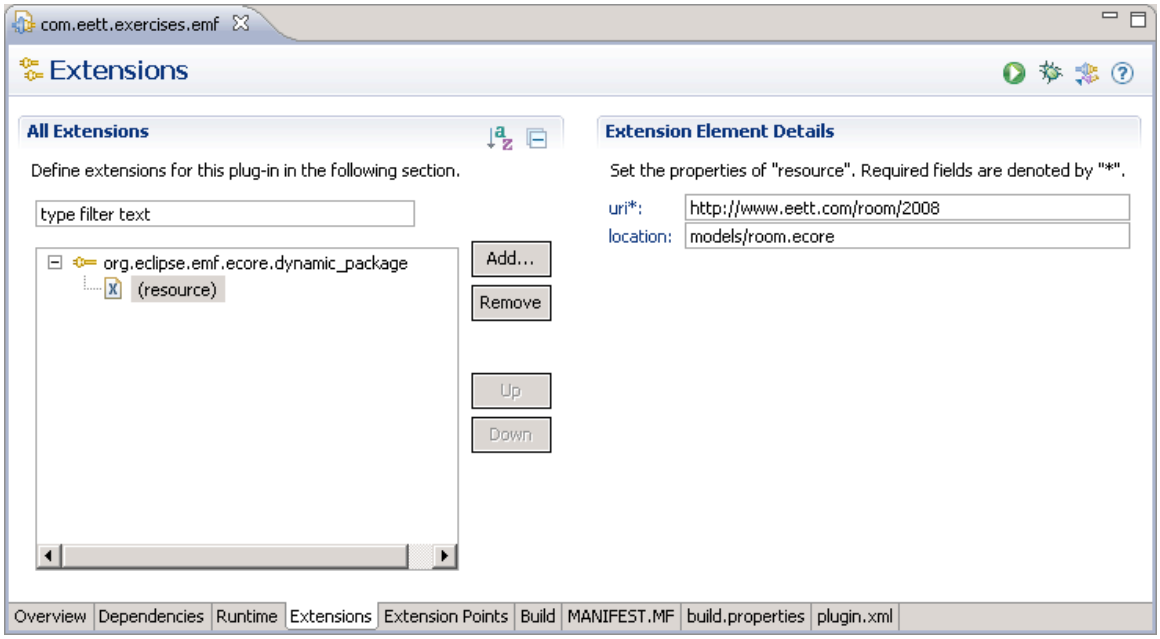


Open the META-INF/MANIFEST.MF in the Plug-in Manifest Editor and change the Name of the plug-in to be EETT EMF Models and the provider to EETT. Save your changes and switch to the Extensions page of the editor.

On the Extensions page click the Add… button. In the Extension Point Selection dialog make sure that Show only extension points from the required plug-ins is unchecked. Then select the com.eclipse.emf.ecore.dynamic_package extension point. Click the Finish button.


New Extension
Extension Point Selection
Create a new Ecore Package Registry for Dynamic Packages extension.
Extension Points
Extension Wizards
Extension Point filter:
org.eclipse.emf.ecore
org.eclipse.emf.ecore.content_handler
org.eclipse.emf.ecore.content_parser
org.eclipse.emf.ecore.dynamic_package
org.eclipse.emf.ecore.extension_parser
org.eclipse.emf.ecore.factory_override
org.eclipse.emf.ecore.generated_package
org.eclipse.emf.ecore.package_registry_implementation
org.eclipse.emf.ecore.protocol_parser
org.eclipse.emf.ecore.uri_mapping
Show only extension points from the required plug-ins
Extension Point Description:
Ecore Package Registry for Dynamic Packages
This extension point is used to register an Ecore resource against a namespace URI (Uniform Resource Identifier) in EMF's global package registry, EPackage.Registry.INSTANCE. The location URI may contain a fragment that specifies the location of a particlar package within the resource; if the fragment is absent, "#/" is assumed. When a model instance is loaded from its serialized
Available templates for ecore package registry for dynamic packages:
< Back
Next >
Finish
Cancel

Set the extension points URI field to be the NS URI of the room.ecore model and the location to the location of the room.ecore model. Save your changes.



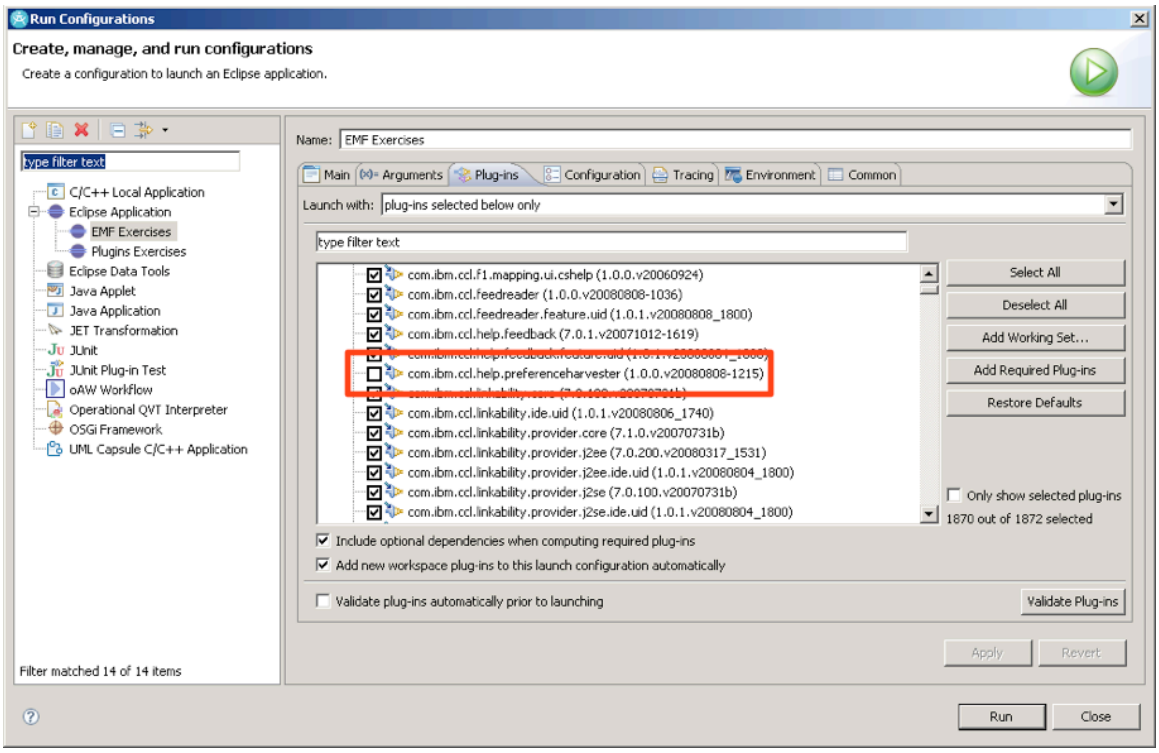
2.2 Creating a Dynamic Instance

Once the metamodel has been created it is possible to create instances of the ROOM metamodel that was defined in the previous exercises. The reflective API of EMF allows a generic editor to be provided to create what are called dynamic instances of the model. This is as opposed to generating the implementation of the metamodel and using either the generated editor or building a custom editor.

In the EMF Ecore editor select the Actor element, and select Create Dynamic Instance from the context menu.

Open the Run Configuration dialog (Run → Run Configurations…). Create a new Eclipse Application configuration, EMF Exercises, and switch to the Plug-ins page. Change the Launch with field to 'plug-ins selected below only'.

In the list of plug-ins uncheck com.ibm.ccl.help.preferenceharvester, and click Apply followed by Run.



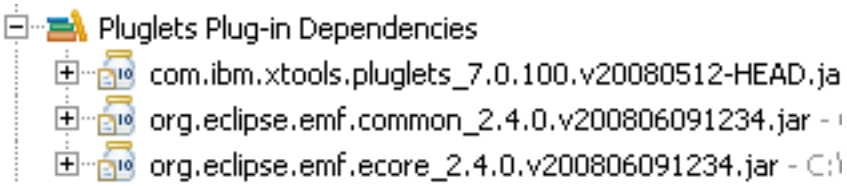
This should launch a runtime workbench, which we will use to programmatically work with our ROOM metamodel. To do this we will use Pluglets, which are an IBM Modeling Platform specific technology for extending the workbench. A pluglet provides script like capabilities, to perform tasks without having to build full plug-ins.

In the runtime workbench create a new Pluglets project, named com.eett.exercises.emf.pluglets. Don't worry about the other settings in the project wizard.

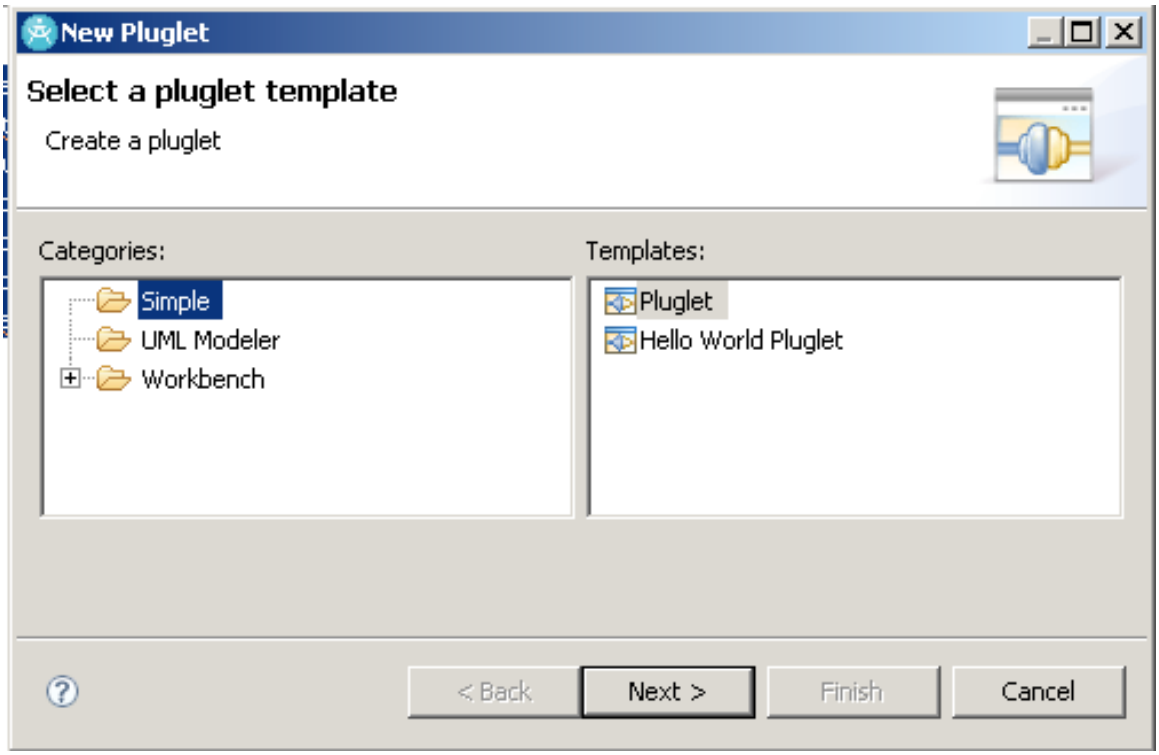
The project will contain a pluglet.xml file which is used to capture dependencies on plug-ins. We going to use EMF in this exercise, therefore we need to add a dependency on org.eclipse.emf.ecore. Open pluglet.xml with a text editor and modify it to look like the following and save the file

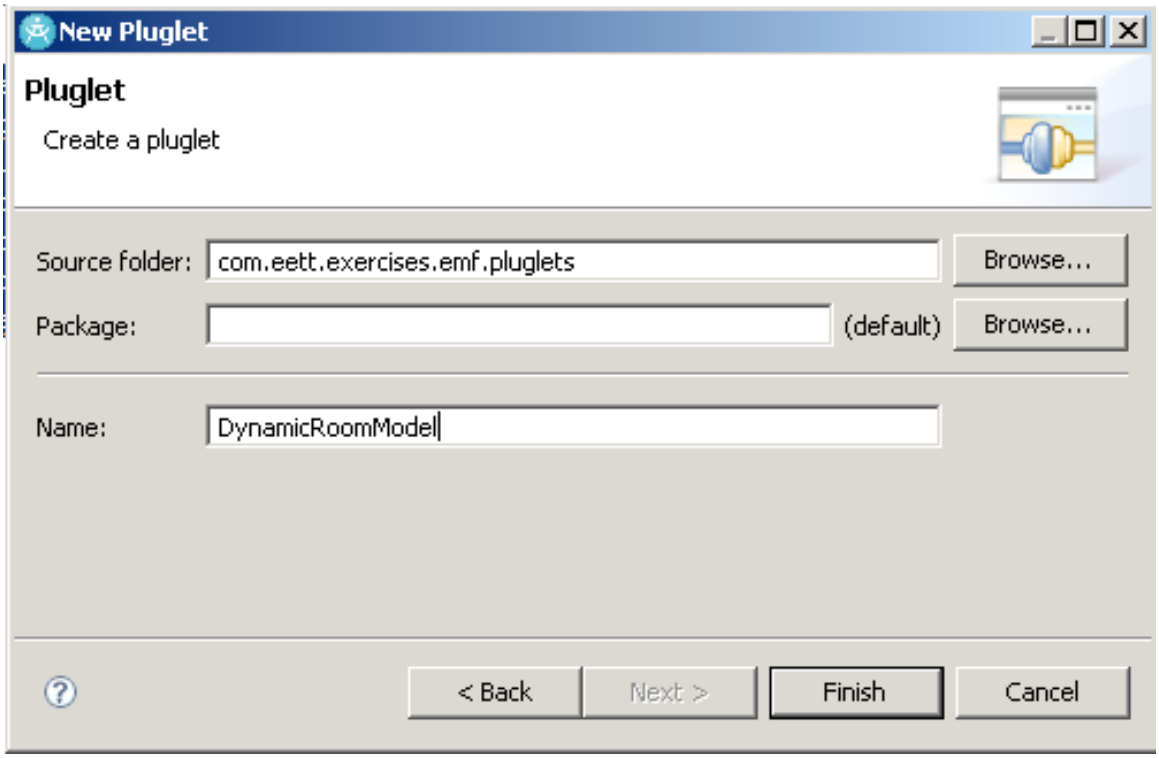
```
<?xml version="1.0" encoding="UTF-8"?>
<pluglets>
   <require>
      <import plugin="com.ibm.xtools.pluglets"/>
      <import plugin="org.eclipse.emf.ecore"/>
   </require>
</pluglets>
```

The Pluglets Plug-in Dependencies should now include org.eclipse.emf.ecore and org.eclipse.emf.common.



Now create a new Pluglet (File → New → Pluglet) in the project. Select the Simple → Pluglet template. Click the Next > button. Set the name of the Pluglet to DynamicROOMModel and click Finish.



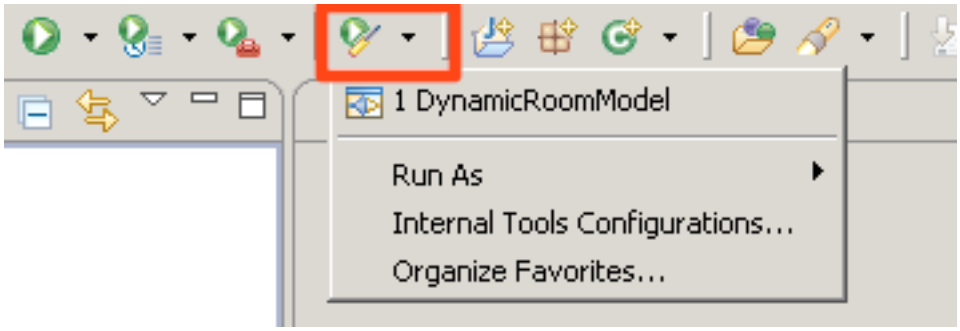

New Pluglet
Pluglet
Create a pluglet
Source folder:
com.eett.exercises.emf.pluglets
Browse...
Package:
(default)
Browse...
Name:
DynamicRoomModel
< Back
Next >
Finish
Cancel

Open the DynamicRoomModel.java file and enter the code described below. This code creates two Actor objects, AbstractDyeingController and DyeingController. They are stored in separate resources, abstractDyeingController.xmi and dyeingController.xmi respectively. We then set the actorSuperclass of DyeingController to be AbstractDyeingController.

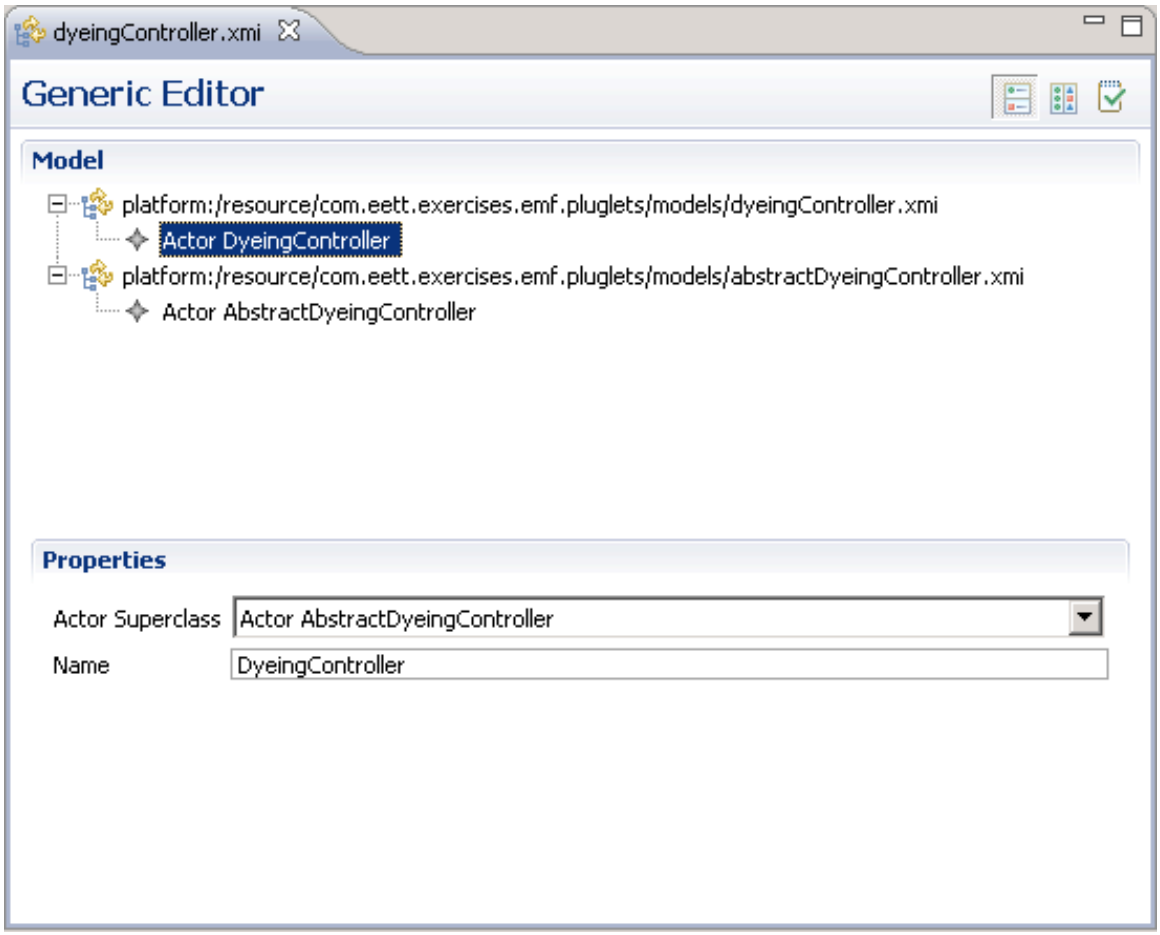
```
import java.io.IOException;

import org.eclipse.emf.common.util.URI;
import org.eclipse.emf.ecore.EClass;
import org.eclipse.emf.ecore.EObject;
import org.eclipse.emf.ecore.EPackage;
import org.eclipse.emf.ecore.EStructuralFeature;
import org.eclipse.emf.ecore.resource.Resource;
import org.eclipse.emf.ecore.resource.ResourceSet;
import org.eclipse.emf.ecore.resource.impl.ResourceSetImpl;

import com.ibm.xtools.pluglets.Pluglet;

public class DynamicRoomModel extends Pluglet {
  private static final String MODELS_FOLDER
    = "platform:/resource/com.eett.exercises.emf.pluglets/models/";

  public void plugletmain(String[] args) {

    // Retrieved the EPackage for the Room metamodel that we
registered
    // It is retrieved using the string we specified as the URI when
we
    // registered it in the dynamic_package extension point
    EPackage room
      = EPackage.Registry.INSTANCE
        .getEPackage("http://www.eett.com/room/2008");

    if(room != null) {
      // Create a ResourceSet so that we can create Resources
      // to store the model elements we create in
      ResourceSet resourceSet = new ResourceSetImpl();

      // Create the Resources to store the objects that we create in
      Resource controllerResource
        = resourceSet.createResource(URI.createURI(
            MODELS_FOLDER + "dyeingController.xmi"));
      Resource abstractControllerResource
        = resourceSet.createResource(URI.createURI(
            MODELS_FOLDER + "abstractDyeingController.xmi"));

      // In order to be able to create an Actor object we need
      // have its EClass which we can get from the EPackage
      EClass actorEClass = (EClass) room.getEClassifier("Actor");

      // Similarly, to set the features of an Actor we
      // need the EStructuralFeature objects for them which we
      // can get from the EClass
      EStructuralFeature actorNameAttribute
        = actorEClass.getEStructuralFeature("name");
      EStructuralFeature actorSuperclass
        = actorEClass.getEStructuralFeature("actorSuperclass");

      // Create the AbstractDyeingController Actor and add it
```

```
        // to the Resource we created for it
        EObject abstractController =
           room.getEFactoryInstance().create(actorEClass);
        abstractController
           .eSet(actorNameAttribute, "AbstractDyeingController");
        abstractControllerResource.getContents()
           .add(abstractController);

        // Create the DyeingController Actor and add it
        // to the Resource we created for it
        EObject controller =
           room.getEFactoryInstance().create(actorEClass);
        controller
           .eSet(actorNameAttribute, "DyeingController");
        controllerResource.getContents().add(controller);

        // Set the actorSuperclass feature of the dyeingController
        // to be the abstractController
        controller.eSet(actorSuperclass, abstractController);

        // Save and unload the Resources we created and added
        // contents to
        try {
           abstractControllerResource.save(null);
           controllerResource.save(null);
           abstractControllerResource.unload();
           controllerResource.unload();
        } catch (IOException e) {
           out.println("Could not save the resources.");
        }

     }
     else {
        out.println("Could not get the room EPackage");
     }
  }

}
```

Run the Pluglet by selecting Run → Internal Tools → DynamicRoomModel or from the toolbar as shown below.



Running the Pluglet should create a new folder models in your project with two files. Open the dyeingController.xmi file with the Generic Editor. Notice how it also loaded the abstractDyeingController.xmi because there is a cross-reference to it (actorSuperclass of DyeingController).

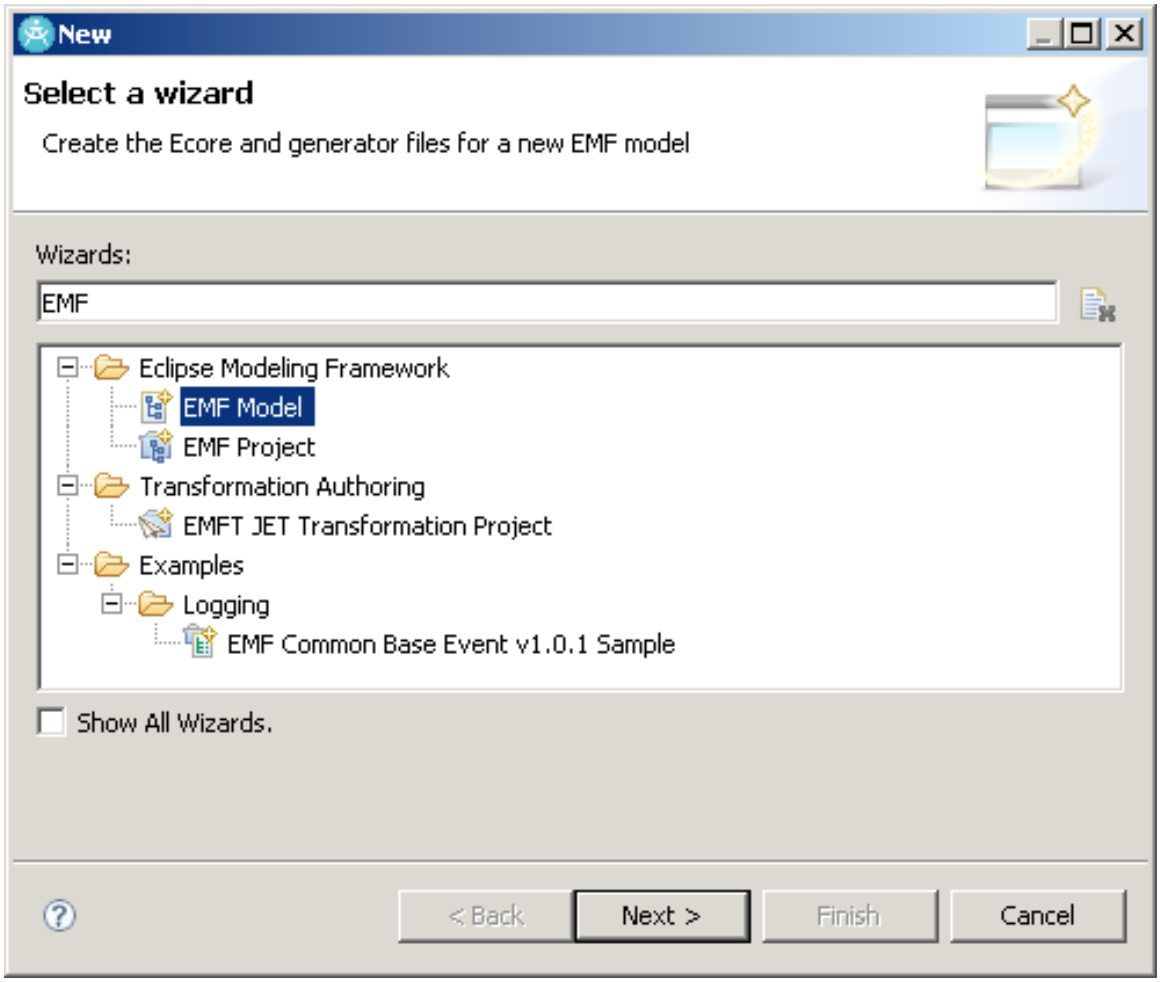


2.3 Generating code for the Ecore Model

The Ecore model created in the previous exercise specifies the concepts, relationships and capabilities within our ROOM domain. In order to be able to generate code for this model we need to create a generator model that decorates the metamodel you defined with additional information to help with generation.

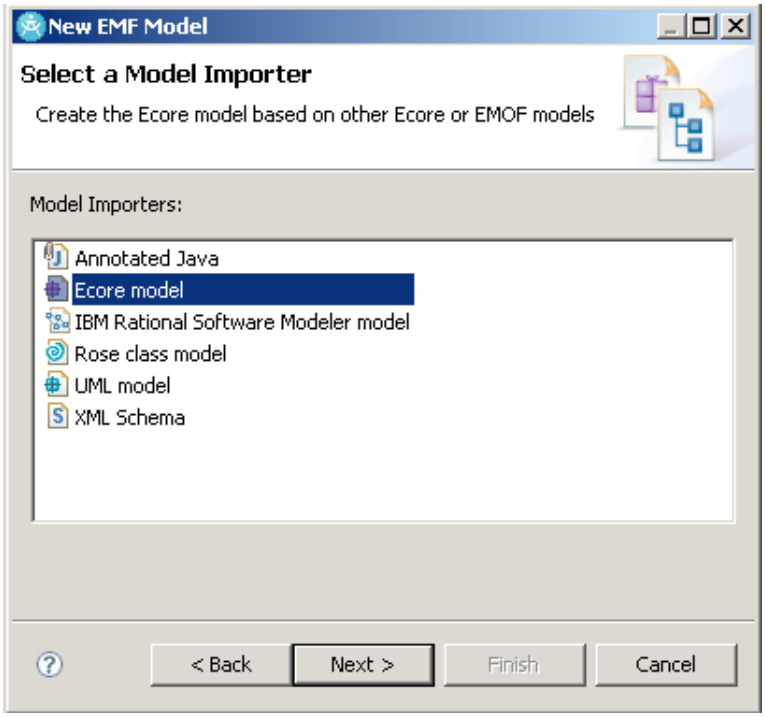
On the models folder in the com.eett.exercises.emf project right-click and select New → Other…

In the New wizard select EMF Model under the Eclipse Modeling Framework folder and click Next >

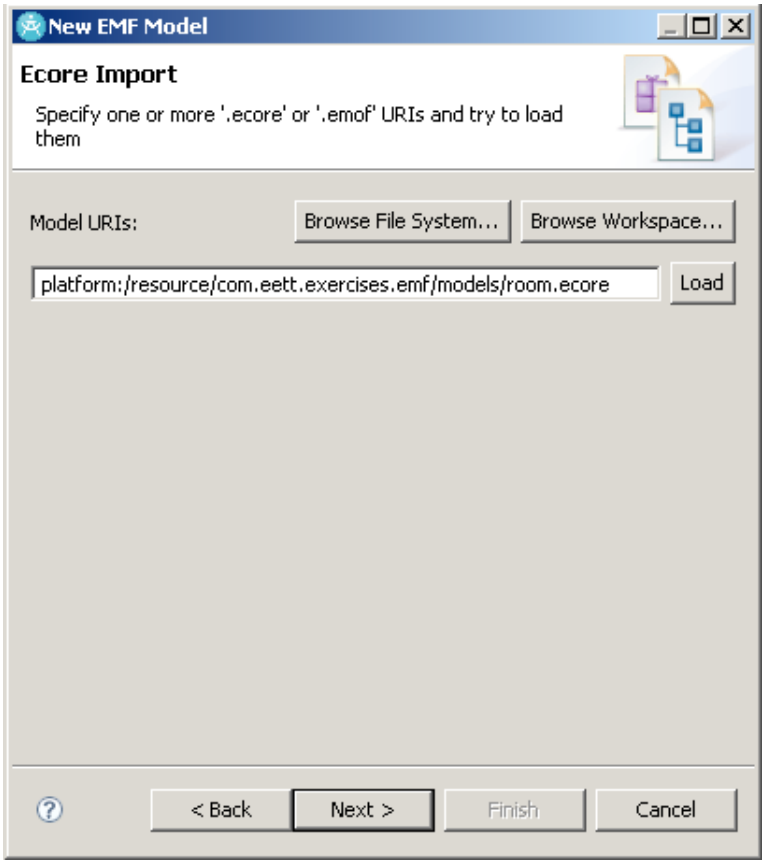


Set the file name to room.genmodel and click the Next > button

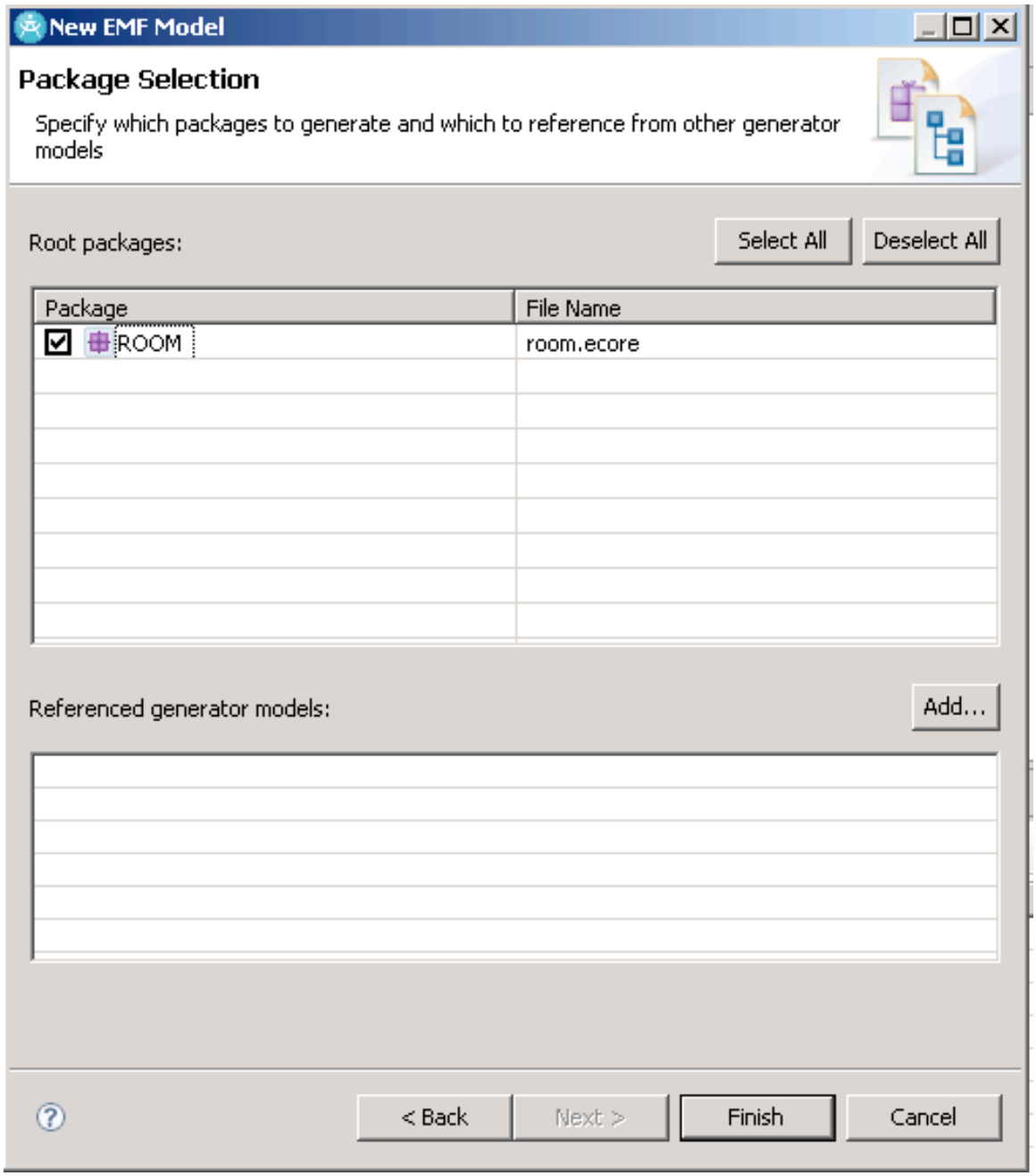
A Model Importer must be selected to create our generator model, select the Ecore Model option and click Next >



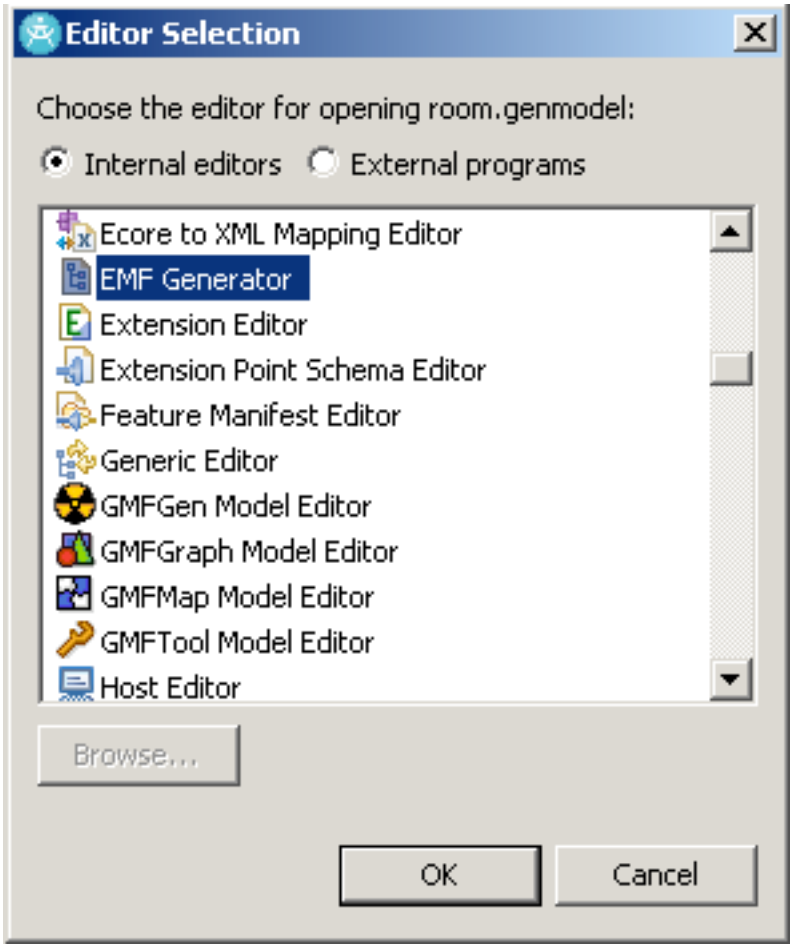
On the Ecore Import page use the Browse Workspace to locate and select the room.ecore model and click the Load button and then Next >



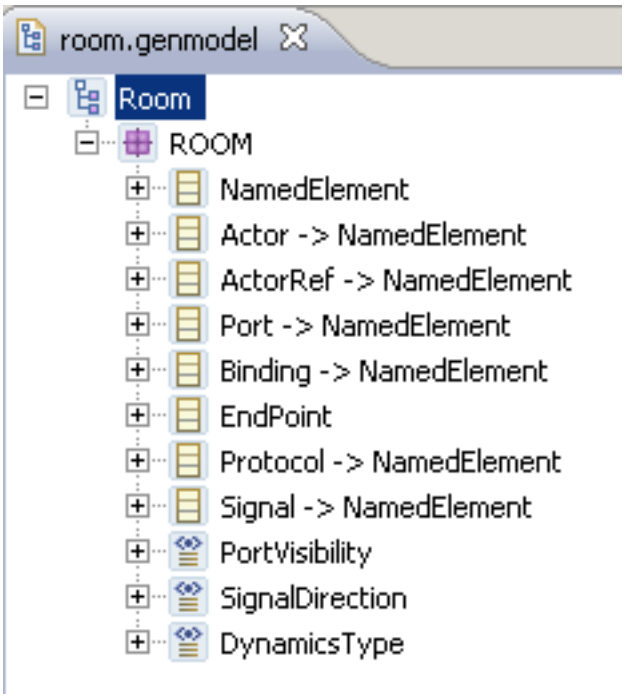
The following dialog should appear, select the Finish button



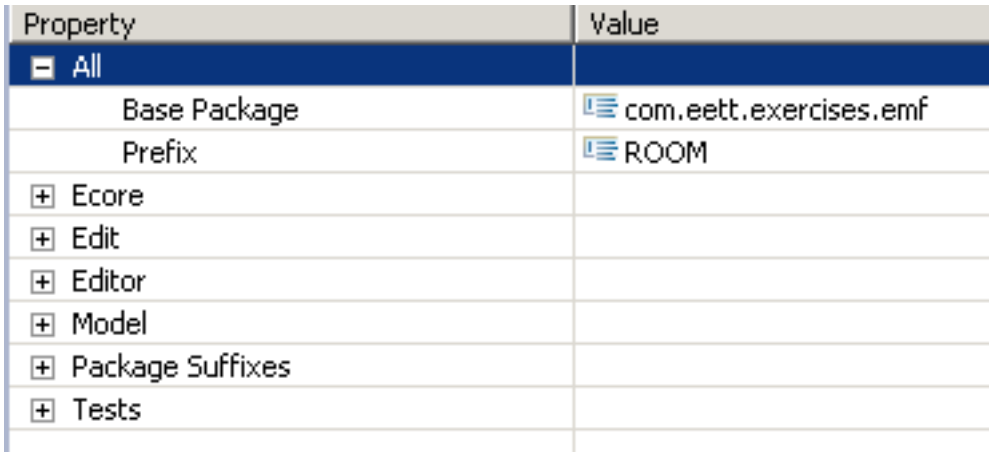
Open the new room.genmodel with the EMF Generator editor,



The model should look like the following

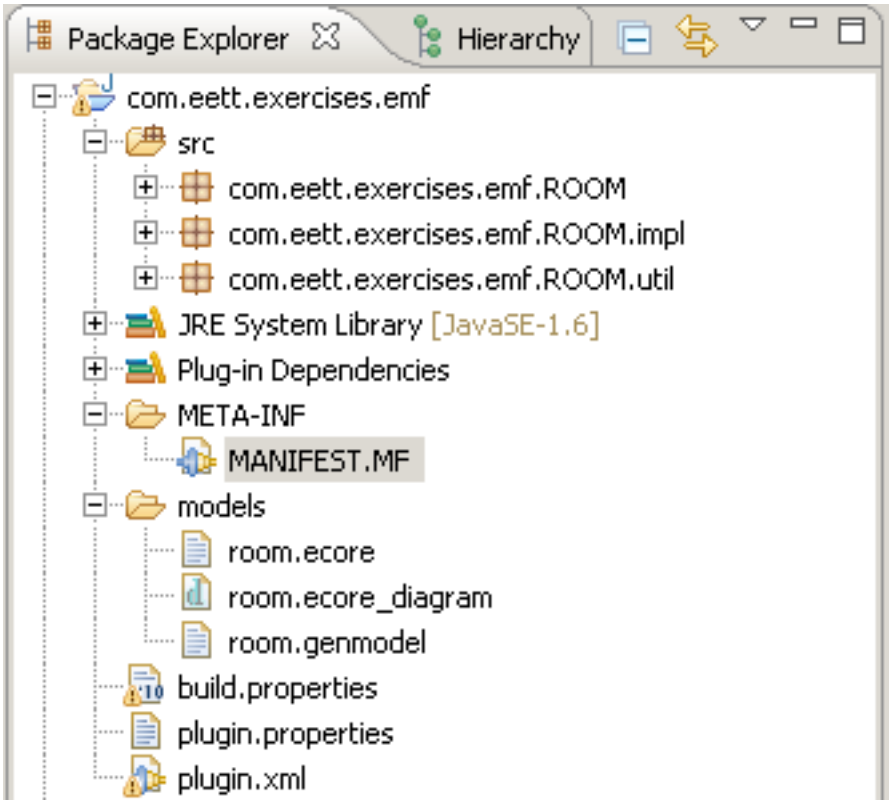


Explore the generator model observing the additional properties that have been added to the elements from our Ecore model. At this point the only property that we need to change is Base Package on the root EPackage ROOM. Change this property to com.eett.exercises.emf, this is the package that the generated code will be generated into.

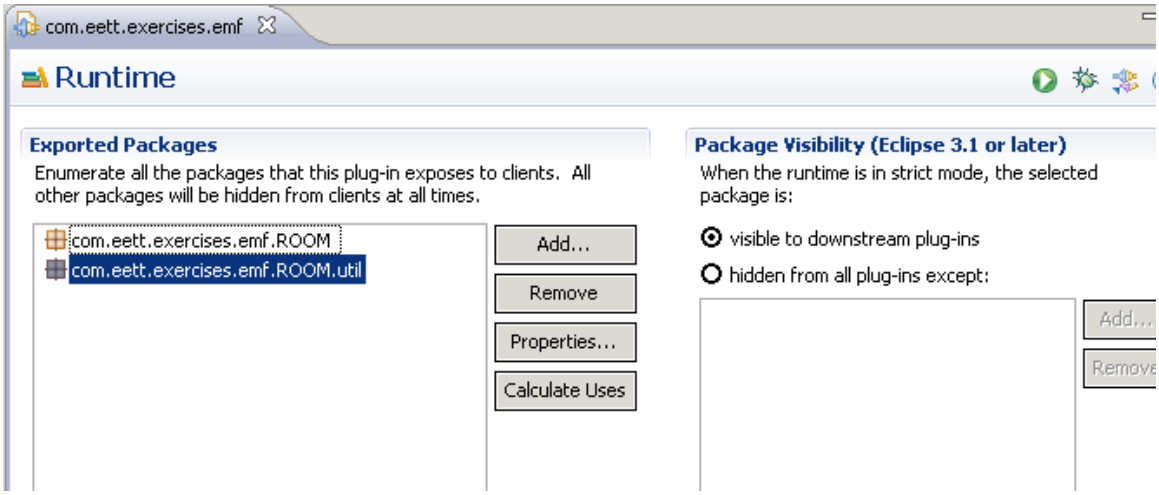


With the generator model open right-click on the root package element and select Generate All, this will generate three new plug-ins (com.eett.exercises.emf.edit, com.eett.exercises.emf.editor, and com.eett.exercises.emf.test) and add source to the com.eett.exercises.emf project that the model is in. It will also modify the com.eett.exercises.emf project adding the plug-in and Java nature to the project.

The com.eett.exercises.emf project should now resemble

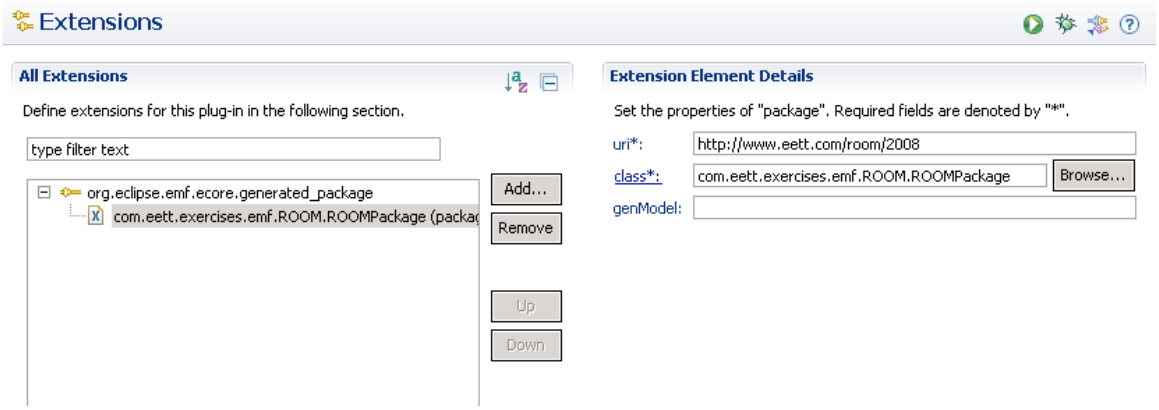


If there are errors in the three other projects we need to update the plug-in manifest for the com.eett.exercises.emf. Open the MANIFEST.MF file in the Plug-in Editor and change to the Runtime page. We need to export the com.eett.exercises.emf.ROOM and com.eett.exercises.emf.ROOM.util packages that were generated because the .edit, .editor and .test plug-ins are dependent on them.



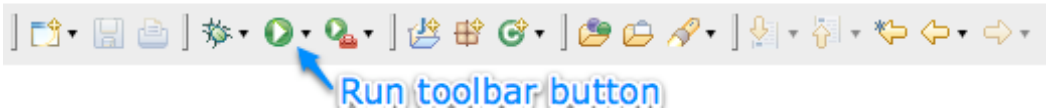

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: Emf
Bundle-SymbolicName: com.eett.exercises.emf;singleton:=true
Bundle-Version: 1.0.0
Require-Bundle: org.eclipse.emf.ecore
Export-Package: com.eett.exercises.emf.ROOM,
 com.eett.exercises.emf.ROOM.util
Bundle-RequiredExecutionEnvironment: JavaSE-1.6
```

We need to change the registration of the metamodel to point to the generated package. Comment out the org.eclipse.emf.ecore.dynamic_package extension in plugin.xml and add a new extension org.eclipse.emf.ecore.generated_package. Set the URI to be http://www.eett.com/room/2008 and the class to com.eett.exercises.emf.ROOM.ROOMPackage.

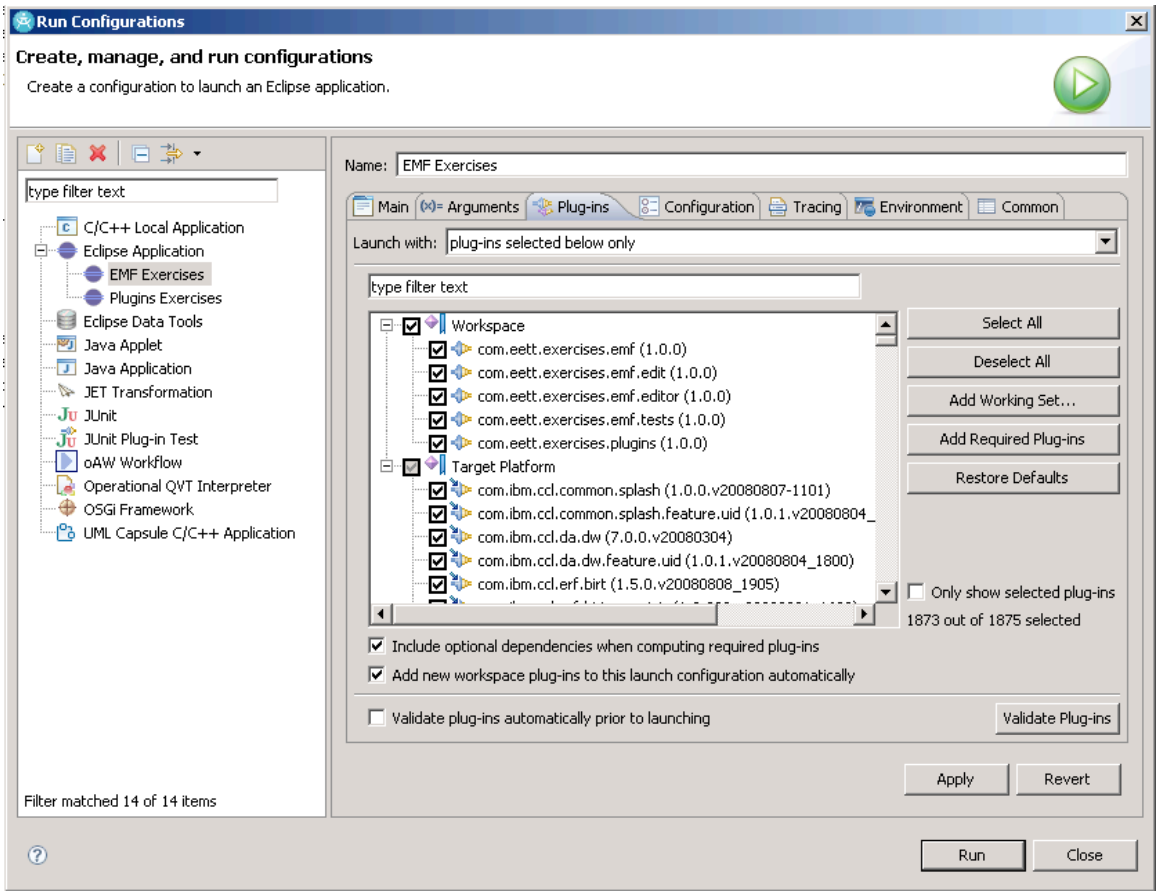


For now we won't worry about the code that was generated, instead we will create a model using the generated model editor.

Switch to the Java perspective and open the Run Configurations dialog by selecting Run → Run Configurations… from the main menu or by using the toolbar.

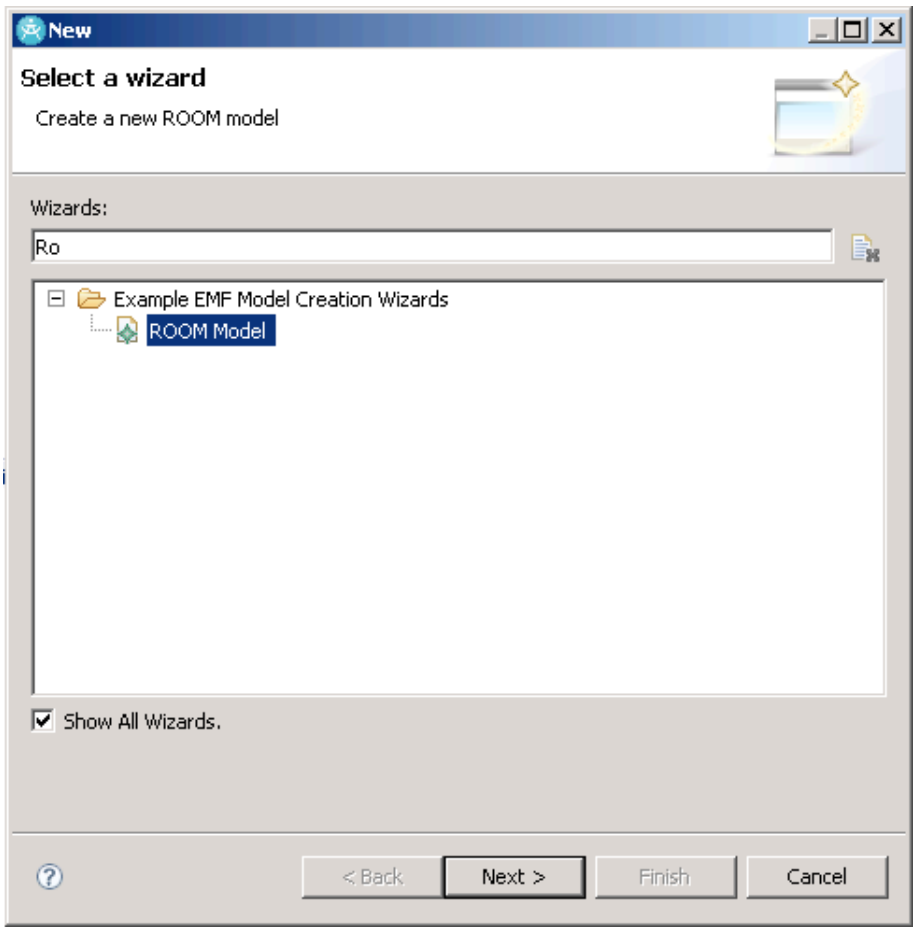


Select EMF Exercises Run Configuration by selecting the Eclipse Application entry on the left and make sure that our new plug-ins are included.



Now click on the Apply button followed by the Run button, this should launch a Runtime Workbench that will enable you to use the editor that was generated for the ROOM metamodel.

To create a ROOM model select the models folder in our com.eett.exercises.emf.pluglets project and File → New → Other… In the New wizard select the ROOM Model wizard and click Next >.



Set the name of the model to DyeingController.room and click Next >. In the ROOM Model wizard set the Model Object to Actor and click Finish.

This will create a new resource with an Actor object in it and open it in the ROOM Editor, which is customized to the ROOM metamodel. Notice that the shortcoming of our current metamodel is that we have no top container element allowing us to create other elements of our model in the same resource.

Exit the runtime workbench and modify the metamodel to include a Model EClass that can contain Actors and Protocols. Reload the generator model (in the EMF Generator editor, Generator → Reload… from the main menu.) Regenerate the model and re-launch the runtime workbench to be able to create a ROOM Model with Model as the Model Object.

Possible improvements

- Change the Wizard category of the ROOM Model in the wizard
- By changing the _UI_Wizard_category property in the plugin.properties file
- Add a perspective where the ROOM Model is listed in the New Menu with having to go through the Select a wizard

2.4 Implement a derived attribute and operation

In this exercise we will add a derived attribute and an operation into our model and then provide the logic for them. An Actor has a reference to Port and a port has different attributes, one of which is visibility. We will consider all public Ports to be interface ports, so we can derive the list of interface ports from the 'ports' existing ports reference. Similarly, we may want to have an operation on an Actor for creating an interface port, given a name.

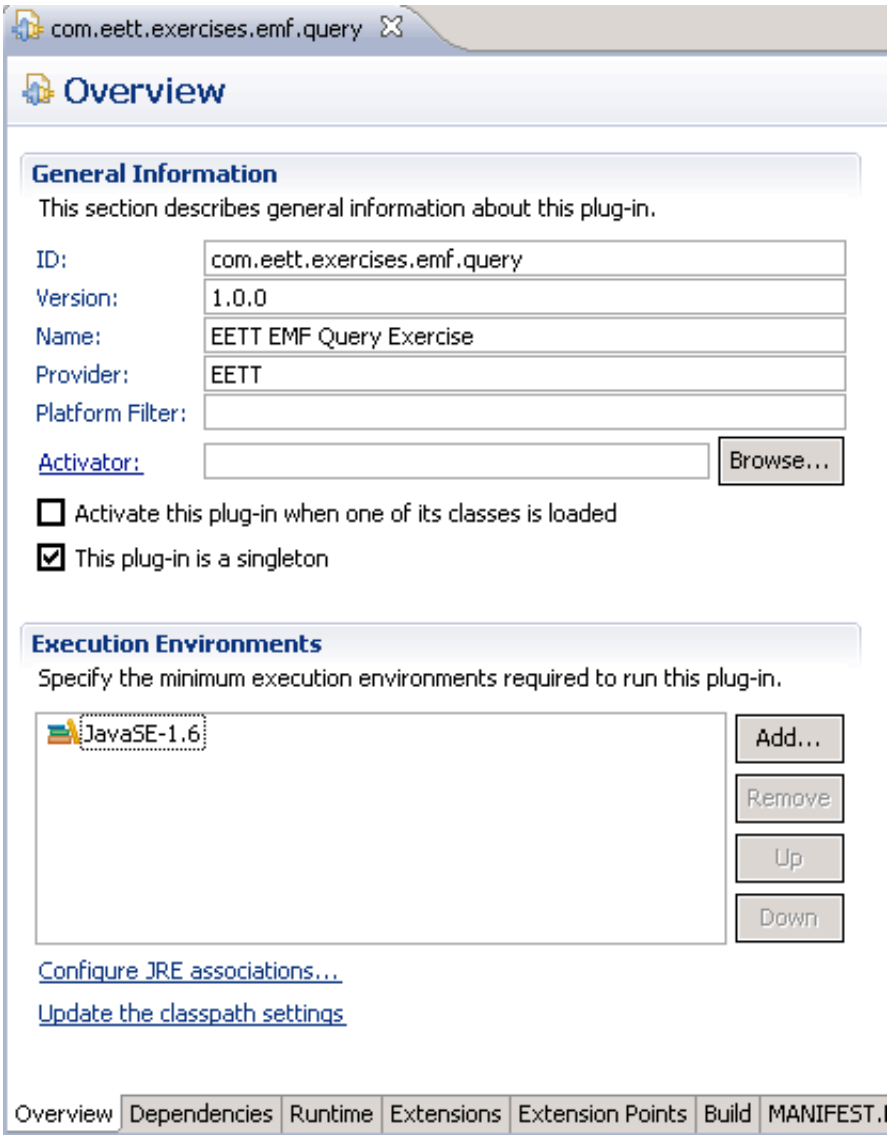
Open the room.ecore model in the Sample Ecore Model Editor and modify the Actor EClass adding

2.5 Querying our model

In this exercise you will create a plug-in that extends the ROOM Model Editor with a query that will find all Actor's that do not have a actorSuperclass. In order to do this we will add an action to the model editor that invokes the query we will write.

Start by creating a new plug-in project with

ID	com.eett.exercises.emf.query,
Name	EETT EMF Query Exercise
Provider	EETT
Version	1.0.0
This plug-in is a singleton	☑



Switch to the Dependencies page of the Plug-in Editor and add the following dependencies

- org.eclipse.ui
- org.eclipse.core.runtime
- org.eclipse.emf.ecore
- org.eclipse.emf.query
- com.eett.exercises.emf
- com.eett.exercises.emf.editor

In order for the query to accessible from the ROOM Editor we need to add an extension to the editor. Switch to the Extensions page of the Plug-in Editor and click the Add… button in the All Extensions section.

From the Extension Point Selection dialog select the org.eclipse.ui.editorActions extension point (you may have to uncheck the 'Show only extension points from the required plug-ins' option if you haven't all the dependencies listed above.)

If an editorContribution isn't automatically added for you, select the extension point and New → editorContribution from its context menu. Set the details for the editorContribution to:

id	com.eett.exercises.emf.query.editorContribution
targetID	com.eett.exercises.emf.ROOM.presentation.ROOMEditorID

The targetID field specifies the identifier that was generated for the ROOM editor, this is necessary for the workbench to know the specific editor that we are contributing to. A list of available editors can be found by clicking the Browse… button beside the field.

Add a menu to the editorContribution through its context menu and set its details as shown in the following table. The path field identifies the menu that we are contributing to in the ROOM editor, this id is defined in the ROOM editor plug-in that was generated from the ROOM EMF model. Add a separator to this menu called additions.

id	com.eett.exercises.emf.queryMenuID
label	&Query
path	com.eett.exercises.emf.ROOMMenuID/addtions

Add an action to the editorContribution through its context menu and set its details as shown in the following table. We are adding this action to the menu that we defined in the previous step, as referenced in the menubarPath. In the next step we will create the class we have defined in the class field.

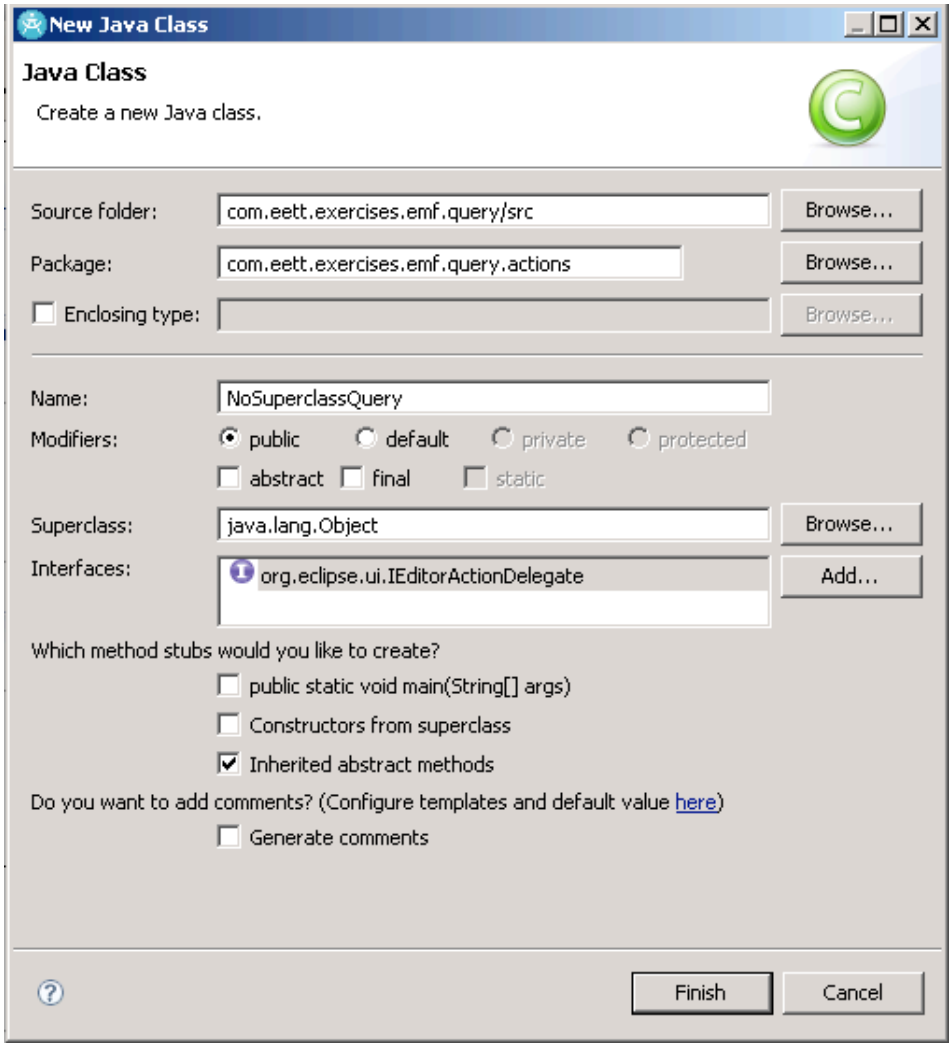
id	com.eett.exercises.emf.query. NoSuperclassQuery
label	Actors with No Superclass
class	com.eett.exercises.emf.query.actions.NoSuperclassQuery
menubarPath	com.eett.exercises.emf.ROOMMenuID/ com.eett.exercises.emf.queryMenuID/additions

We do not want the action to be enabled for anything so we will add an enablement to our action to control when it can be invoked. Add an enablement with an objectClass through the action's context menu and set the name to org.eclipse.emf.ecore.EObject which will restrict the enablement to only objects of type EObject.

The plugin.xml page should now resemble:

```
<?xml version="1.0" encoding="UTF-8"?>
<?eclipse version="3.2"?>
<plugin>
  <extension
    point="org.eclipse.ui.editorActions">
    <editorContribution
      id="com.eett.exercises.emf.query.editorContribution"
      targetID="com.eett.exercises.emf.ROOM.presentation.ROOMEditorID">
      <menu
        id="com.eett.exercises.emf.queryMenuID"
        label="&amp;Query"
        path="com.eett.exercises.emf.ROOMMenuID/additions">
        <separator name="additions" />
      </menu>
      <action
        class="com.eett.exercises.emf.query.actions.NoSuperclassQuery"
        id="com.eett.exercises.emf.query.NoSuperclassQuery"
        label="Actors with No Superclass"
        menubarPath="com.eett.exercises.emf.ROOMMenuID/
com.eett.exercises.emf.queryMenuID/additions"
        style="push">
        <enablement>
          <objectClass name="org.eclipse.emf.ecore.EObject"></objectClass>
        </enablement>
      </action>
    </editorContribution>
  </extension>
</extension>
```

We will now create the handler for our query action in the src folder of the plugin add a Class using the wizard (New → Class). Set the name to NoSuperclassQuery and the package to com.eett.exercises.emf.query.actions. The handler must implement the IEditorActionDelegate.



In the newly created class there are two methods that were are interested implementing setActiveEditor and run, we will also add an additional operation to perform the actually query.

The setActiveEditor will allow us to capture the current editor and to access the selected model element to use as the source for our query. To support the method add an editor field to the class of type ROOMEditor. The behavior of setActiveEditor follows.

```
@Override
public void setActiveEditor(IAction action, IEditorPart targetEditor)
{
	if(editor instancoeof ROOMEditor) {
		editor = (ROOMEditor) targetEditor;
	}
}
```

The run action will invoke the query that we will write and then select the objects returned by the query in the editor. The behavior of run follows.

```
@Override
public void run(IAction action) {
	Collection<EObject> selectedObjects
		= new ArrayList<EObject>();

	// get the selected object from the editor
	if(editor !- null
		&& editor.getSelection() instanceof
IStructuredSelection){

		IStructuredSelection structuredSelection =
			(IStructuredSelection) editor.getSelection();
		for(Object next : structuredSelection.toList()){
			if(next instanceof EObject){
				selectedObjects.add((EObject) next);
			}
		}
	}

	// execute the query
	Collection<EObject> result = performQuery(selectedObjects);

	// select the query results in the editor
	if(!result.isEmpty()){
		editor.setSelectionToViewer(result);
	}
}
```

Finally, we write a query that takes the selected element in the editor and find all the Actors that do not have the actorSuperclass reference set.

```
private Collection<EObject> performQuery
		(Collection<EObject> selectedObjects) {

	// create a condition that tests whether an Actor's
	// actorSuperclass feature to see if it is null
	EObjectCondition condition = new
EObjectReferenceValueCondition(
		ROOMPackage.eINSTANCE.getActor_ActorSuperclass(),
		EObjectInstanceCondition.IS_NULL);

	SELECT query = new SELECT(
			new FROM(selectedObjects),
			new WHERE(condition));

	return query.execute();
}
```

This completes the creation of the plug-in that will perform the query. It needs to be tested in a runtime workbench. Create a runtime workbench including this plug-in and the ones that it requires. Open an existing ROOM model or create a new one using the ROOM Editor, ensure that the ROOM Editor menu contains a query sub-menu.

3 UML Module Exercises

3.1 UML Model Exercise

3.1.1 What this exercise is about

In this exercise, you will create a UML model of a dyeing system. The system that consists of a dye tank that has a fill valve and a drain valve, the tank has a high sensor to determine when it is filled to its maximum and low sensor to determine when it is getting low on dye. A controller receives signals from the sensors in order to open and close the appropriate valves.

At the end of this exercise, you should be able to:

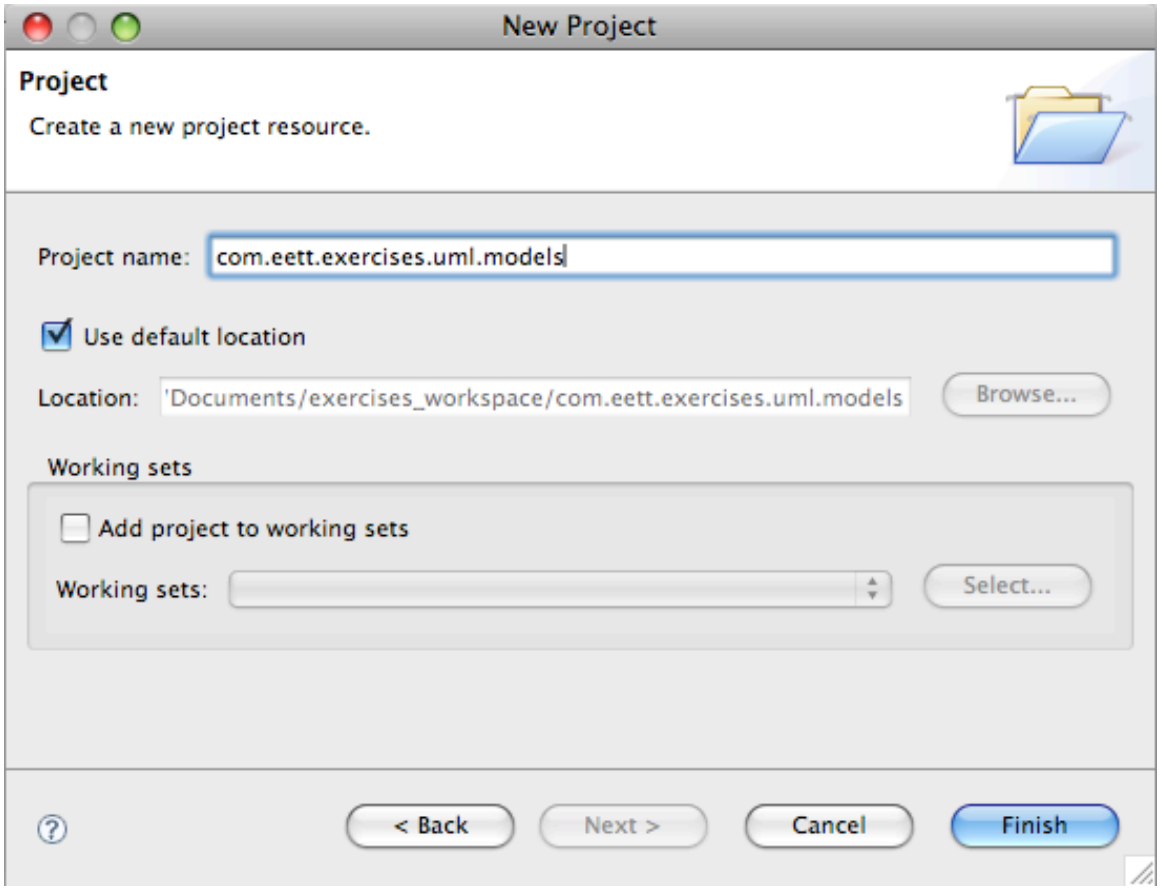
Create a UML model using the UML Model Editor, and

Programmatically create UML model elements

3.1.2 Exercise Instructions

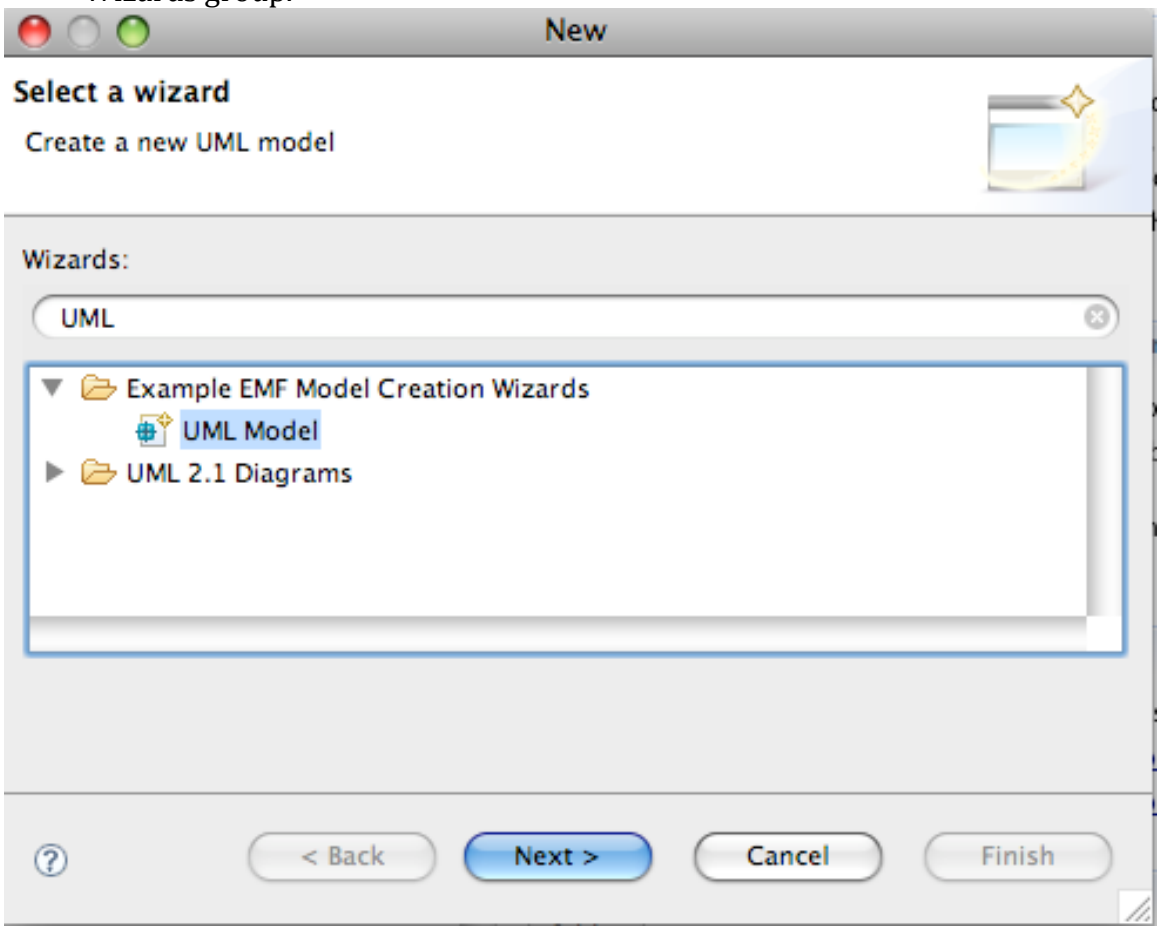
Start by creating a project that will contain the models that we create in this exercise and others.

1. Create a new basic Eclipse project
    1. Select File → New → Project… → Project
    2. Set the Project name to com.eett.exercises.uml.models
    3. Keep Use default location checked
    4. Click Finish >

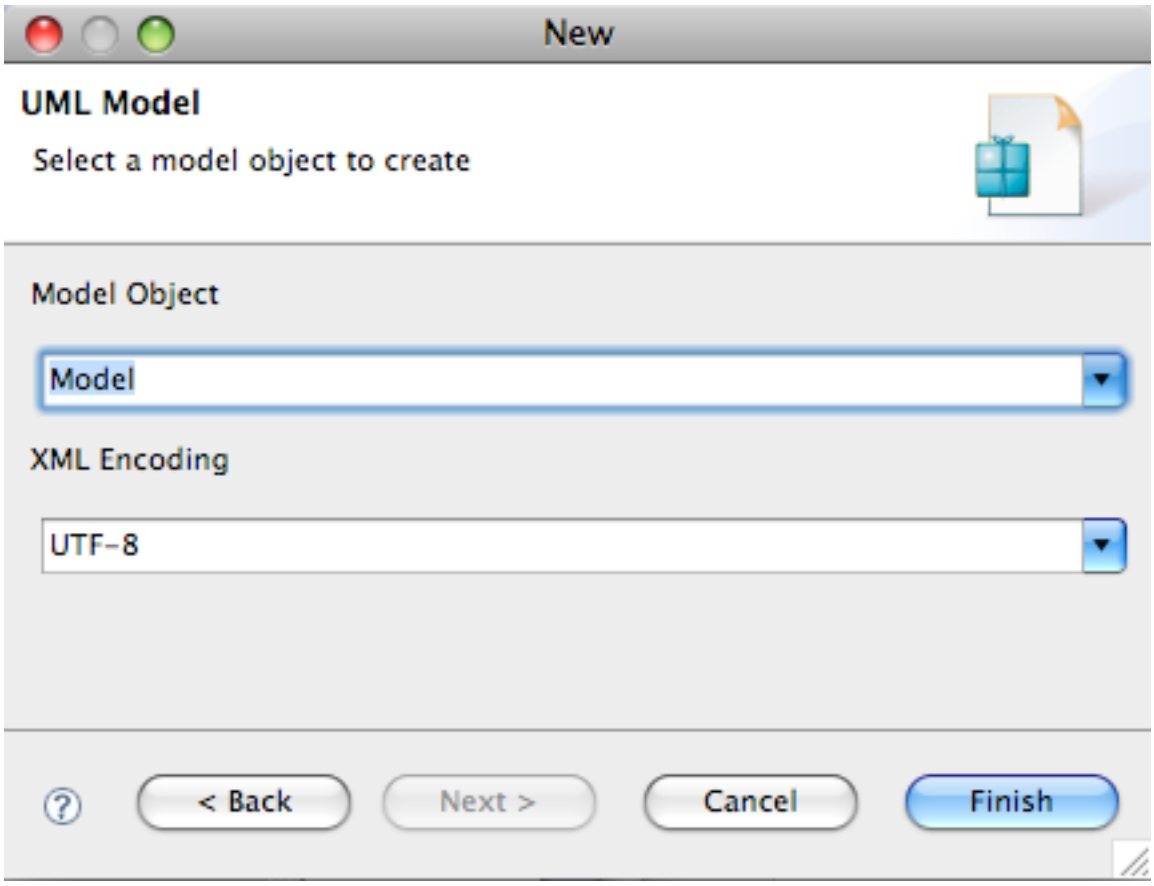


You should now have an empty project in your workspace

2. Use the project context menu we will add a folder to store our models in.
   1. Select the project and New → Folder from its context menu.
   2. Set the Folder name to models and click Finish
3. We will now create a UML model in our project and populate it with our dyeing system model
   1. Select the models folder and New → Other… from its context menu.
   2. In the New wizard select UML Model in the Example EMF Model Creation Wizards group.



   3. Set the File Name to dyeingSystem.uml and click Next >
   4. Set the Model Object field to Model and leave the XML Encoding field to the default value and click Finish



The project in your workspace should now contain a dyeingSystem.uml file, that you can open using the UML Model Editor.

3.2 UML Keywords Exercise

3.2.1 What this exercise is about

In this exercise, you will create a UML model using the UML Model Editor and tag the elements in the model using key words. You will also extend the UML model editor with actions to automatically add specific keywords to model elements.
At the end of this exercise, you should be able to:

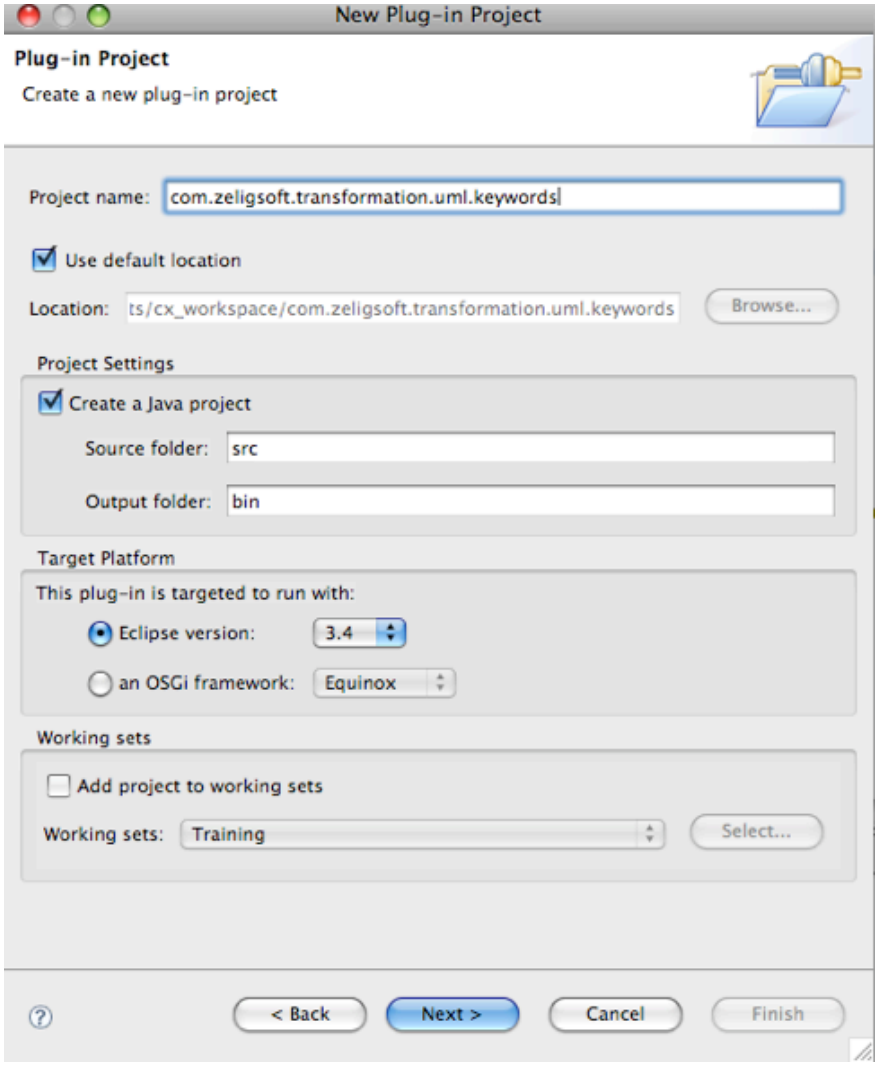
- Set key words in a UML model using the UML Model Editor
- Add actions to the UML Model Editor to tag elements with key words

3.2.2 Exercise Instructions

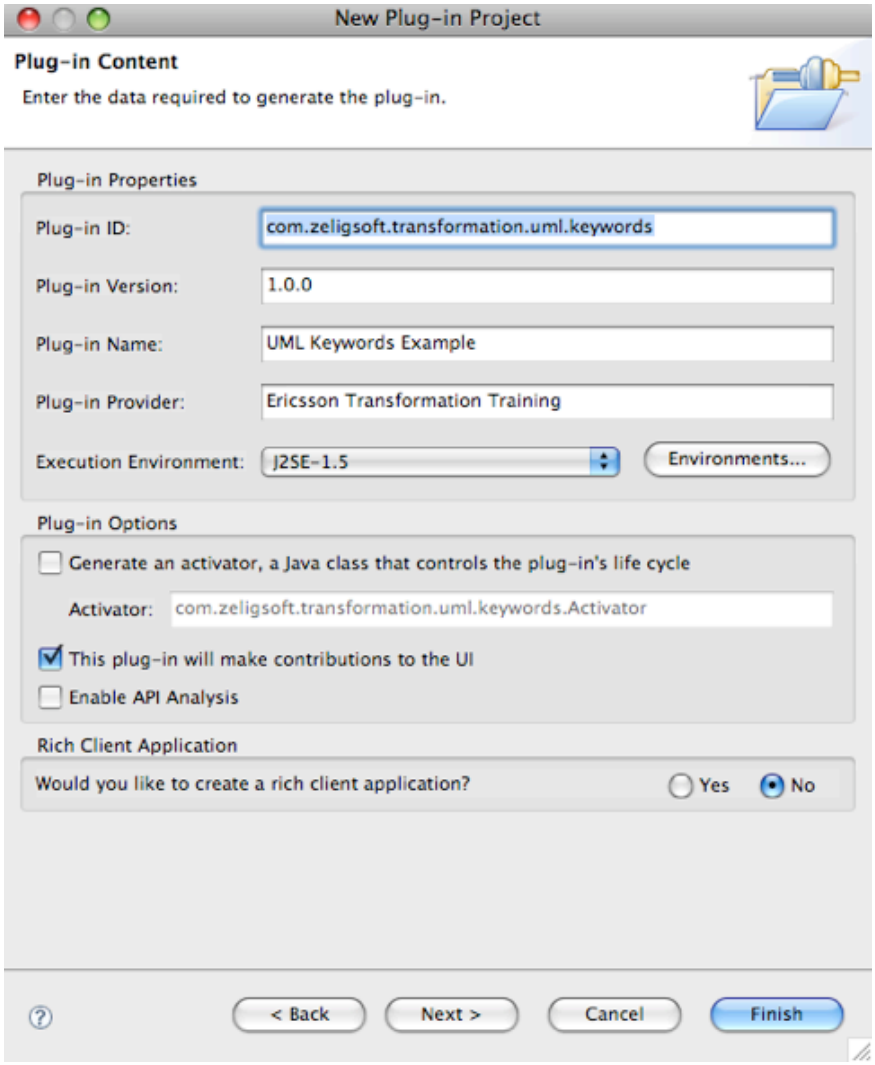
Start by creating a project with the name com.eett.exercises.uml.keywords in the workspace.

4. Switch to the Plug-in Development perspective, if not already there.
    1. Select Window → Open Perspective → Other… → Plug-in Development

5. Create a new Plug-in project as we will be adding actions to an editor
    1. Select File → New → Project… → Plug-in Project
    2. Set the Project name to com.eett.exercises.uml.keywords
    3. Keep Use default checked
    4. Keep Create a Java project checked
    5. Make sure that the Eclipse version is set to 3.4
    6. Click Next >

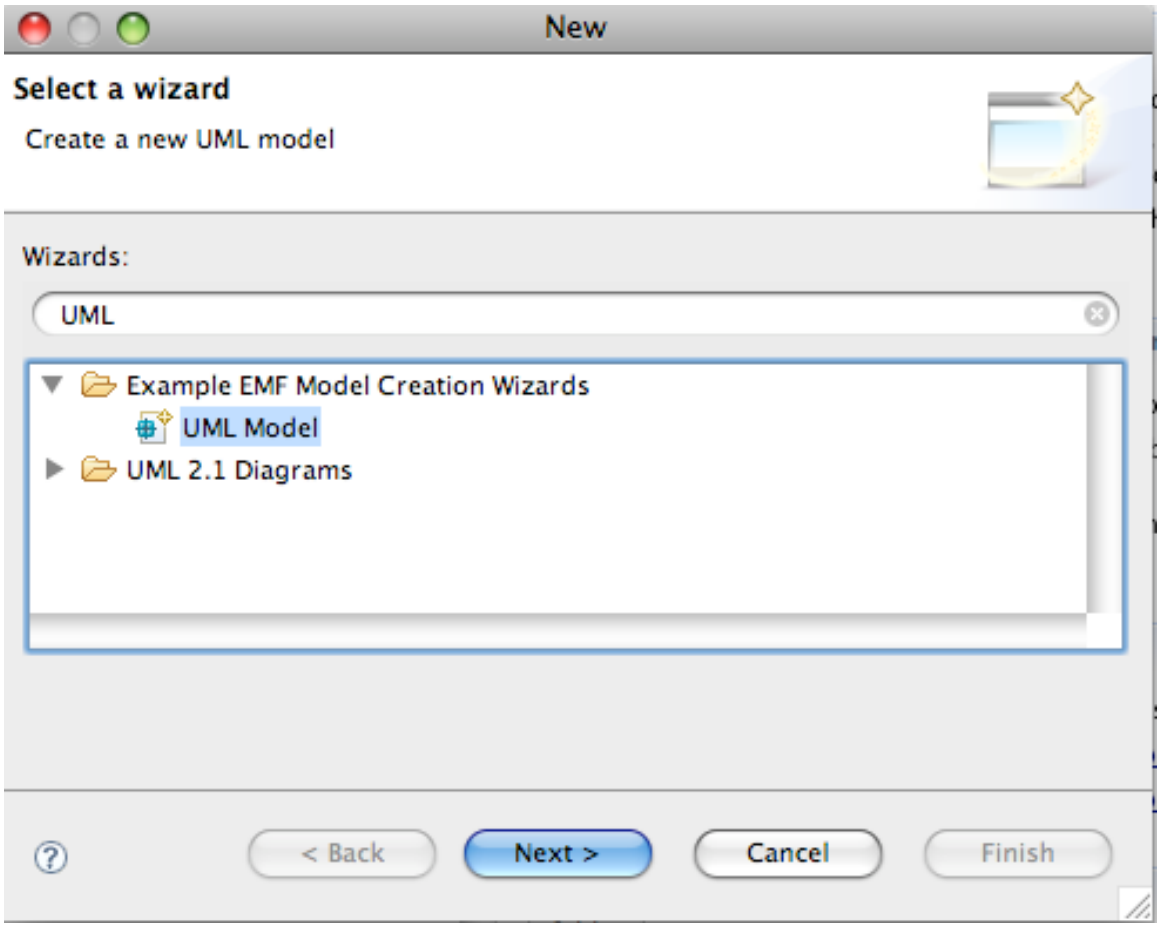


6. Configure the Plug-in Content dialog
   1. Keep the defaults for Plug-in ID and Plug-in Version
   2. Set the Plug-in Name to UML Keywords Example
   3. Set the Plug-in Provider to EETT
   4. Make sure that “This plug-in will make contributions to the UI” is the only Plug-in Option checked
   5. Make sure that Would you like to create a rich client application? Is set to No
   6. Click Finish

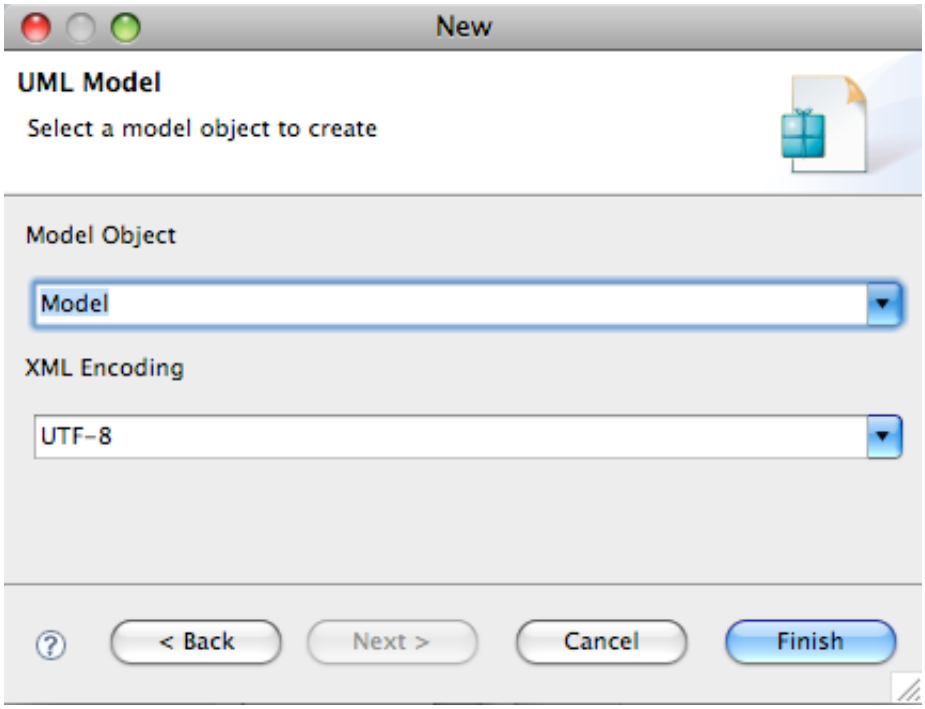


7. Create a UML model named dyeingSystem.uml in which we will build a UML model of a Dyeing system that consists of a dye tank that has a fill valve and a drain valve, the tank has a high sensor to determine when it is filled to its maximum and low sensor to determine when it is getting low on dye. A controller receives signals from the sensors in order to open and close the appropriate valves.
   1. Select the project created in the last step and New → Folder from the context menu
   2. Change the name of the folder to models

3. Select the models folder and File → New → Other… → UML Model and click Next >



8. Set the File Name to dyeingSystem.uml and click **Next >**
9. Set the Model Object field to Model and leave the XML Encoding field to the default value and click **Finish**



3.3 UML Profiles Exercise

3.3.1 What this exercise is about

In this exercise, you will create a Profile defining a ROOM like model. It will allow us to define, in UML, models that use the ROOM concepts. This includes for example identifying classes as ROOMActors and ports as ROOMPorts.

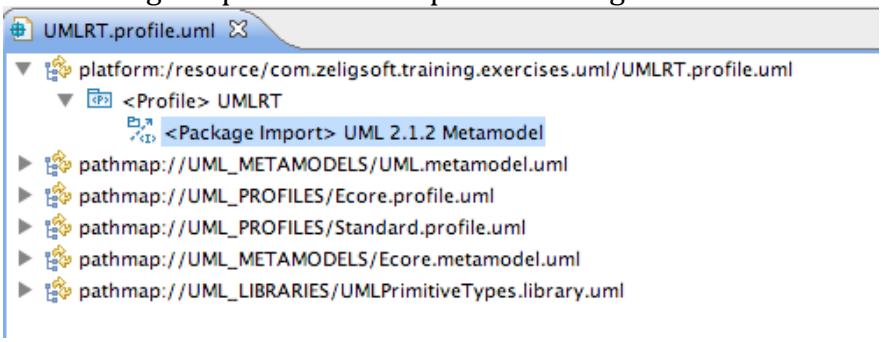
3.3.2 What you should be able to do

At the end of this exercise, you should be able to:

- Define a UML profile using the UML Model Editor
- Register and publish the profile to make it available at run-time
- Apply and use the profile in a UML model
- Add actions to the UML Model Editor to create elements with the stereotypes applied

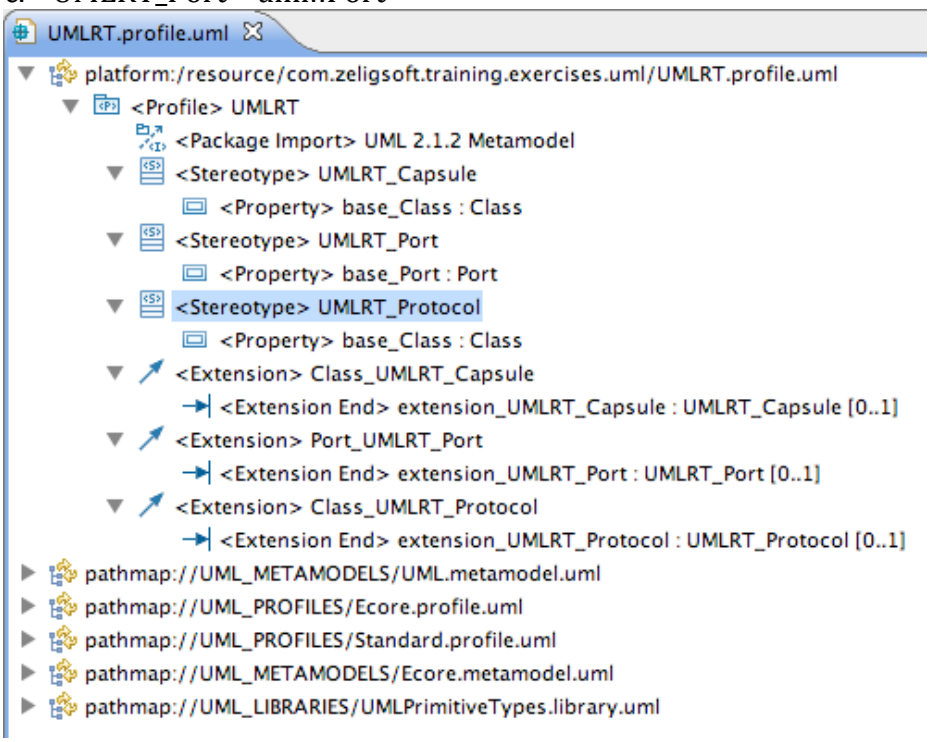
3.3.3 Exercise instructions

1. Select the **com.eett.exercises.uml** project and then choose File | New | Other…
2. Select UML Model in the Example EMF Model Creation Wizards folder and click the Next > button
3. Enter UMLRT.profile.uml as the file name and click the Next > button
4. Select Profile as the Model Object and click the Finish button
5. Open the new model file with the UML Model Editor an change the name of the Profile element to UMLRT
6. Load Resource, pathmap://UML_METAMODELS/UML.metamodel.uml
7. Add a Package Import and set Imported Package to uml

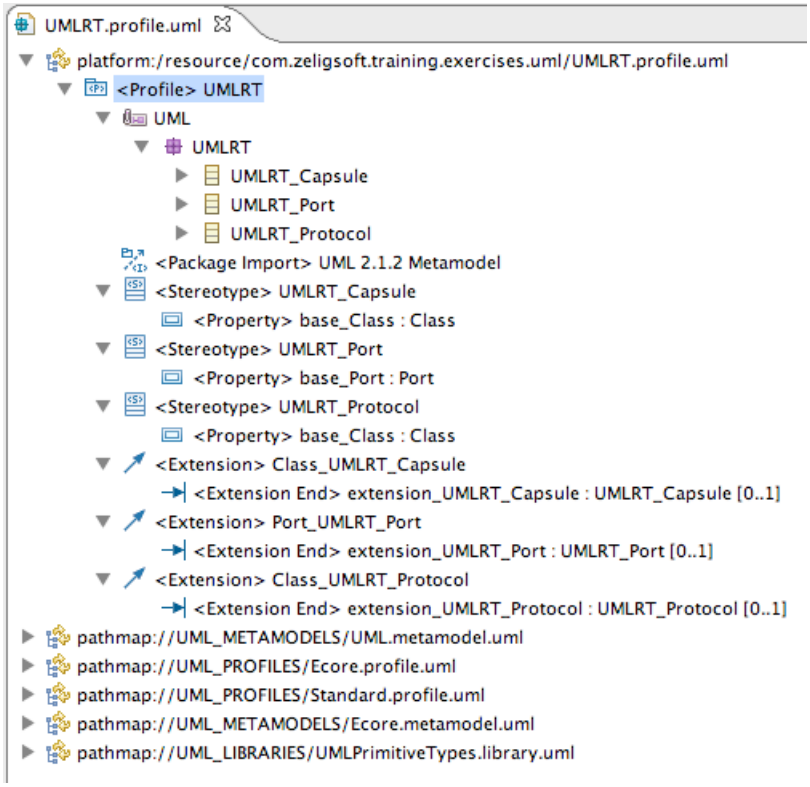


8. In the Profile create Stereotypes
    a. UMLRT_Capsule
    b. UMLRT_Port
    c. UMLRT_Protocol

9. For each of the Stereotypes add a metaclass extension, select the Stereotype and select UML Editor | Stereotype | Create Extension … from the main menu and select the appropriate metaclass
    a. UMLRT_Capsule – uml::Class
    b. UMLRT_Protocol – uml::Class
    c. UMLRT_Port – uml::Port

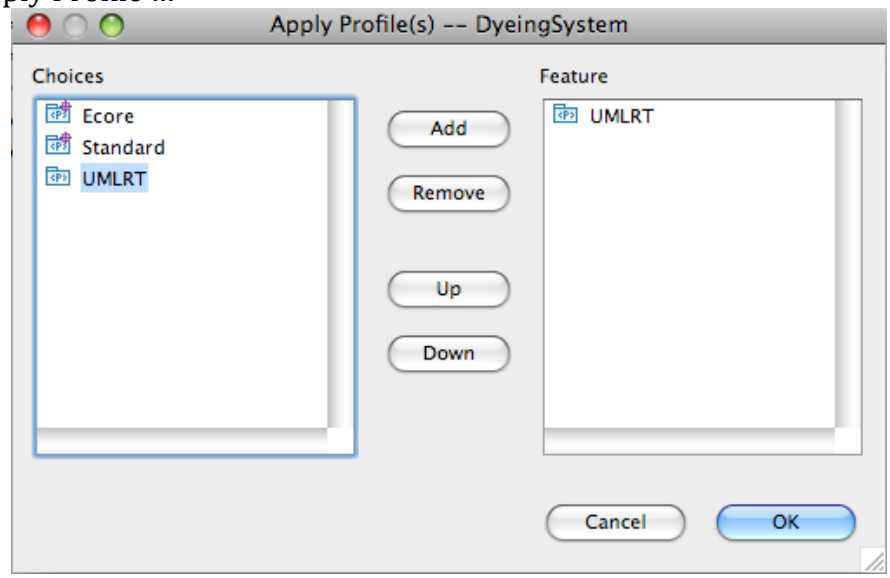


10. Make sure the UMLRT Profile element is selected in the model and then select UML Editor | Profile | Define, keeping the default options click the Ok button



3.4 Applying the Profile to a Model

1. Open the DyeingSystem.uml model with the UML Editor
2. Select UML Editor | Load Resource from the main menu
3. Enter UMLRT.profile.uml as the resource location and click the Ok button
4. Select the UMLRT Model element in the editor and UML Editor | Package | Apply Profile …



5. Select Valve Class in the model and UML Editor | Element | Apply Stereotype … and choose the UMLRT_Capsule Stereotype
    a. Repeat for DyeingSystemController
    b. Repeat for DyeingSystem
6. Select the Ports on each of the elements and apply the UMLRT_Port stereotype
7. Select the ValveControl Class and apply the UMLRT_Protocol stereotype

4 Transformation Exercises

4.1 M2M Setup

In order execute transformations from the ROOM Editor we need to add an extension to the editor. Create a new Plug-in project.

ID	com.eett.exercises.m2m.ui
Version	1.0.0
Name	EETT Transformations UI Exercise
Provider	EETT

Add the following dependencies.

- org.eclipse.core.runtime
- org.eclipse.ui
- com.eett.exercises.emf
- com.eett.exercises.emf.editor

Switch to the Extensions page of the Plug-in Editor and click the Add… button in the All Extensions section.

From the Extension Point Selection dialog select the org.eclipse.ui.editorActions extension point (you may have to uncheck the 'Show only extension points from the required plug-ins' option if you haven't all the dependencies listed above.)

If an editorContribution isn't automatically added for you, select the extension point and New → editorContribution from its context menu. Set the details for the editorContribution to:

id	com.eett.exercises.emf.query.editorContribution
targetID	com.eett.exercises.emf.ROOM.presentation.ROOMEditorID

The targetID field specifies the identifier that was generated for the ROOM editor, this is necessary for the workbench to know the specific editor that we are contributing to. A list of available editors can be found by clicking the Browse… button beside the field.

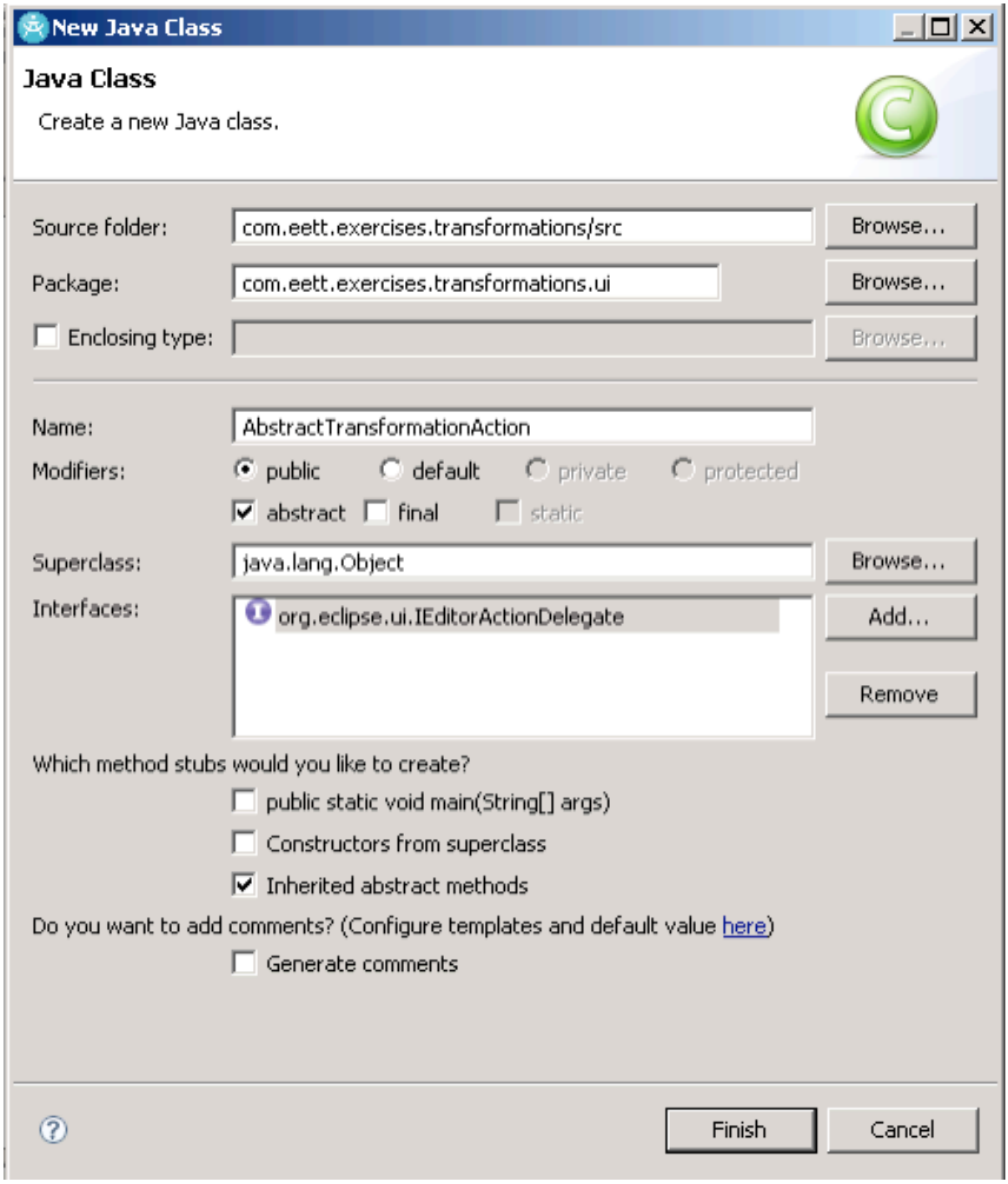
Add a menu to the editorContribution through its context menu and set its details as shown in the following table. The path field identifies the menu that we are contributing to in the ROOM editor, this id is defined in the ROOM editor plug-in that was generated from the ROOM EMF model. Add a separator to this menu called additions.

id	com.eett.exercises.transformations.MenuID
label	&Transform
path	com.eett.exercises.emf.ROOMMenuID/addtions

The plugin.xml page should now resemble:

```
<?xml version="1.0" encoding="UTF-8"?>
<?eclipse version="3.2"?>
<plugin>
  <extension point="org.eclipse.ui.editorActions">
    <editorContribution
      id="com.eett.exercises.transformation.editorContribution"
      targetID="com.eett.exercises.emf.ROOM.presentation.ROOMEditorID">
      <menu
        id="com.eett.exercises.transformation.MenuID"
        label="&amp;Query"
        path="com.eett.exercises.emf.ROOMMenuID/additions">
        <separator name="additions" />
      </menu>
    </editorContribution>
  </extension>
</plugin>
```

We will now create an abstract handler for our transformation actions in the src folder of the plugin add an abstract Class using the wizard (New → Class). Set the name to AbstractTransformationAction and the package to com.eett.exercises. transformations.actions. The handler must implement the IEditorActionDelegate.



The setActiveEditor method will allow us to capture the current editor and to access the selected model element to use as the source for our transformation. To support the method add an editor field to the class of type ROOMEditor. The behavior of setActiveEditor follows.

```
@Override
public void setActiveEditor(IAction action, IEditorPart targetEditor)
{
	if(editor instancoeof ROOMEditor) {
		editor = (ROOMEditor) targetEditor;
	}
}
```

We will add an additional method to the class to return the selected object. If there is more than one object selected it will pick the first one in the list.

```
// Return the object that is currently selected in the active editor
// if more than one is selected return the first one
protected EObject getSelectedObject() {
	if(editor != null
		&& editor.getSelection() instanceof IStructuredSelection)
{
		IStructuredSelection structuredSelection =
			(IStructuredSelection) editor.getSelection();
		for(Object next : structuredSelection.toList()){
			if(next instanceof EObject){
				return (EObject) next;
			}
		}
	}
	return null;
}
```

4.2 M2M with Java

In this exercise we will create a model-to-model mapping from our ROOM model to a simplified model of the Java programming language. This requires the java.ecore modeled that will be provided. Before doing the exercises generate and register the model. The remainder of the exercise assumes that you have done this.

Create a new Plug-in Project.

ID	com.eett.exercises.m2m.java
Version	1.0.0
Name	EETT M2M Java Exercise
Provider	EETT

Dependencies
org.eclipse.emf.java
com.eett.exercises.emf

Add an action to the ROOM Editor in the com.eett.exercises.transformations plug-in. Add an action to the editorContribution through its context menu and set its details as shown in the following table. We are adding this action to the menu that we defined in the previous step, as referenced in the menubarPath. In the next step we will create the class we have defined in the class field.

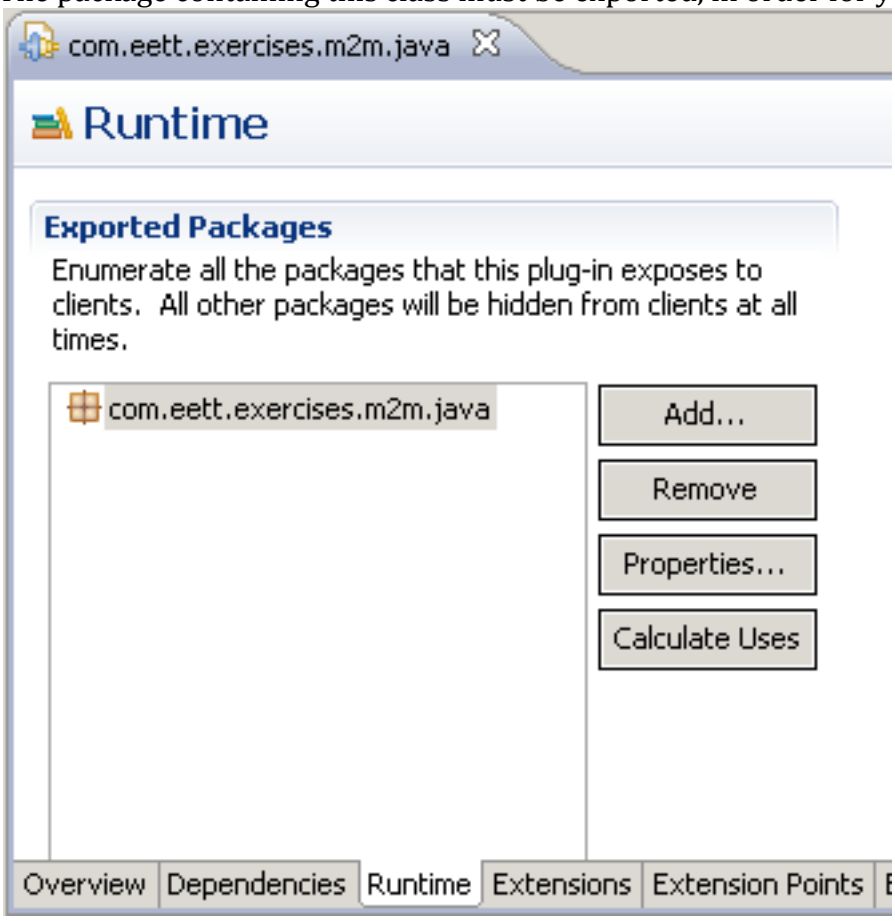
id	com.eett.exercises.transformation.java.transform
label	Java Transform
class	com.eett.exercises.transformations.ui.actions.ROOM2JavaAction
menubarPath	com.eett.exercises.emf.ROOMMenuID/ com.eett.exercises.transformation.MenuID /additions

We do not want the action to be enabled for anything so we will add an enablement to our action to control when it can be invoked. Add an enablement with an objectClass through the action's context menu and set the name to com.eett.exercises.emf.ROOM.Model, which will restrict the enablement to only objects of type Model. Add a new handler for this action that specializes the AbstractTransformationAction we created in the previous exercise.

In the com.eett.exercises.m2m.java plug-in create a class ROOM2JavaTransformation in the com.eett.exercises.m2m.java package. This is the class we will use as the entry point for our transformation. This class will have a protected constructor and a single method for now, transform that takes a ROOM Model and creates Java JModel.

```
/**
 * A class that is the entry point of a M2M transformation
 * written in Java. Its purpose is to transform a
 * com.eett.exercises.emf.ROOM.Model into a
 * org.eclipse.emf.java.JModel.
 *
 * @author Zeligsoft
 *
 */
public class ROOM2JavaTransform {
	/**
	 * We only want one of these transform entry point classes
	 * created so we manage the creation of the instance and
	 * make it accessible through this static field.
	 */
	public static final ROOM2JavaTransform INSTANCE =
		new ROOM2JavaTransform();

	/**
	 * Constructor is protected since we do not
	 * allow others to create instances.
	 */
	protected ROOM2JavaTransform() {

	}

	/**
	 * A transformation written in Java that takes as input
	 * a ROOM model and transforms it into a Java model.
	 */
	public JModel transform(Model roomModel) {
		JModel target = JavaFactory.eINSTANCE.createJModel();

		target.setName(roomModel.getName());

		return target;
	}
}
```

The package containing this class must be exported, in order for you to access it.



We now need to invoke this transformation from the action we have created. This means that the com.eett.exercises.transforms plug-in needs a dependency on the Java M2M plug-in. Then we modify the run method in the action to be the following.

```
@Override
public void run(IAction action) {
	// get the selected object in the active editor
	EObject eobject =
		getSelectedObject();

	// this should be a ROOM model since we restricted
	// action to it but we will test it any way
	if(eobject instanceof Model){
		Model roomModel = (Model) eobject;

		// run the transformation and store the result
		JModel jModel = ROOM2JavaTransform
			.INSTANCE.transform(roomModel);

		// persist the model to a resource that has
		// the same name as the source ROOM model and in
		// the same folder
		if(roomModel.eResource()!= null
				&& roomModel.eResource().getURI() != null){
			// create the new URI and resource for the target
			// model by removing the source file extension and
```

```
                    // add the model.java file extension
                          URI jModelURI = roomModel.eResource()
                                      .getURI().trimFileExtension();
                          jModelURI = jModelURI.
                                appendFileExtension("model.java");

                          Resource jModelResource =
                                roomModel.eResource().getResourceSet()
                                      .createResource(jModelURI);
                          // add the result to the new model
                          jModelResource.getContents().add(jModel);

                          try {
                                jModelResource.save(null);
                          } catch (IOException e) {
                                e.printStackTrace();
                                throw new RuntimeException("Trying to
transform an element and an exception was thrown:\n" +
e.getMessage());
                          }

                          // unload and remove the resource from the
                          // source models resource set
                          jModelResource.unload();
                          roomModel.eResource().getResourceSet().
                                getResources().remove(jModelResource);
                    }
                    else {
                          throw new RuntimeException("Trying to
transform an element that is not in a resource.");
                    }
              }
        }
```

Load a runtime workbench and tryout your transformation. Once you are sure that the action is working. Add rules to your m2m.java project that transform an Actor to a JCompilationUnit and a JClass within it. Add a JField to the JClass for each port on the Actor. The JCompilationUnit rule will be called by the transformation we have already created.

4.3 M2M with QVT

Before beginning this exercise it is best to export the projects for the metamodels as plug-ins and restart the Workbench. This requires using File → Export… and exporting them to a folder called dropins in the %RSA_INSTALL%/SDP directory.

In this section we will create a model-to-model transformation using QVT. Start by creating a QVT project com.eett.exercises.m2m.qvt. Add depedencies to the ROOM and Java model projects just as we did in the previous exercise.

Create a transformation ROOM2Java.qvto within the project. The first thing that needs to be done is to define the metamodels that will be used.

```
modeltype roomMM "strict" uses "http://www.eett.com/room/2008";
modeltype javaMM "strict" uses
"http://www.eclipse.org/emf/2002/Java";
```

Now define the transformation that has an in parameter of type roomMM and and out parameter of type javaMM.

```
transformation Room2Java(in room:roomMM, out javaM:javaMM);
```

Now we must define the entry point for the transformation, which will accept a Model element from ROOM and transform it into a target of type JModel. Set the name of the JModel to be the name of the ROOM model.

```
mapping main(in rModel:roomMM::Model, out jModel:javaMM::JModel) {
      init {
            jModel := object JModel{name:= rModel.name};
      }
}
```

Add a rule to the file that maps an Actor or Protocol to a JCompilation and a JClass as a member of the JCompilationUnit. The difference being that a Protocl ends up being an interface.

```
mapping PackageableElement::roomElement2JCompilationUnit()
      : JCompilationUnit
            disjuncts Actor::actor2JCompilationUnit,
                  Protocol::protocol2JCompilationUnit {
}

mapping Actor::actor2JCompilationUnit() : JCompilationUnit {
      name := self.name;
      type += self->map actor2JClass();
}

mapping Protocol::protocol2JCompilationUnit() : JCompilationUnit {
      name := self.name;
      types += self->map protocol2JClass();
}

mapping Protocol::protocol2JClass() : JClass {
      name := self.name;
      interface := true;
}

mapping Actor::actor2JClass() : JClass {
      name := self.name;
}
```

Modify the entry point to iterate through the members of the ROOM model and map. This will use the roomElement2JCompilationUnit rule we wrote.

```
mapping main(in rModel:roomMM::Model, out jModel:javaMM::JModel) {
      init {
            jModel := object JModel{name:= rModel.name};
            elements += rModel.elements->map
                        roomElement2JCompilationUnit();
      }
}
```

To test the transformation create or use an existing ROOM model using the editor. Now create a Run Configuration to test the mapping, Run → Run Configurations… and create a new Operational QVT Interpreter, ROOM2Java. Set the Transformation Module to be the transformation we just developed and make sure that the Generate trace file is checked. Finally, specify the target of the transformation.

Now click on the Run button and examine the model that is created and the generated trace file.

Now extend the transformation to consider the ports on Actors and the signals on Protocols.

4.3.1 For the adventurous

Create a similar QVTO transformation that works on RSA-RTE models and thus against profile used by RSA-RTE.

4.4 M2T with xPand

In this exercise we will map a JModel into Java source. To do this we will use xPand and a workflow. Start by creating a new openArchitectureWare Project, com.eett.exercises.m2t.xpand. Make sure that the Create a sample is checked.

Now modify the MANIFEST.MF to have a dependency on org.eclipse.emf.java.

We won't need the files in src/metamodel so they can be deleted. The xPand template should also be renamed to GenerateJava.xpt and an import for the Java metamodel. Which will allow us to build an M2T for our Java models.

```
«IMPORT java»
```

We now need to define the transformation entry point, which is defined for a JModel.

```
«DEFINE main FOR JModel»
«ENDDEFINE»
```

Add a rule for writing each JCompilationUnit to a file with the .java extension.

```
«DEFINE writeJCompilationUnit FOR JCompilationUnit»
        «IF this.name != null»
                «FILE this.name + ".java"»


                «ENDFILE»
        «ENDIF»
«ENDDEFINE»
```

Modify the workflow file that was generated. So that it is named generateJava.oaw and that it works with our models and metamodels.

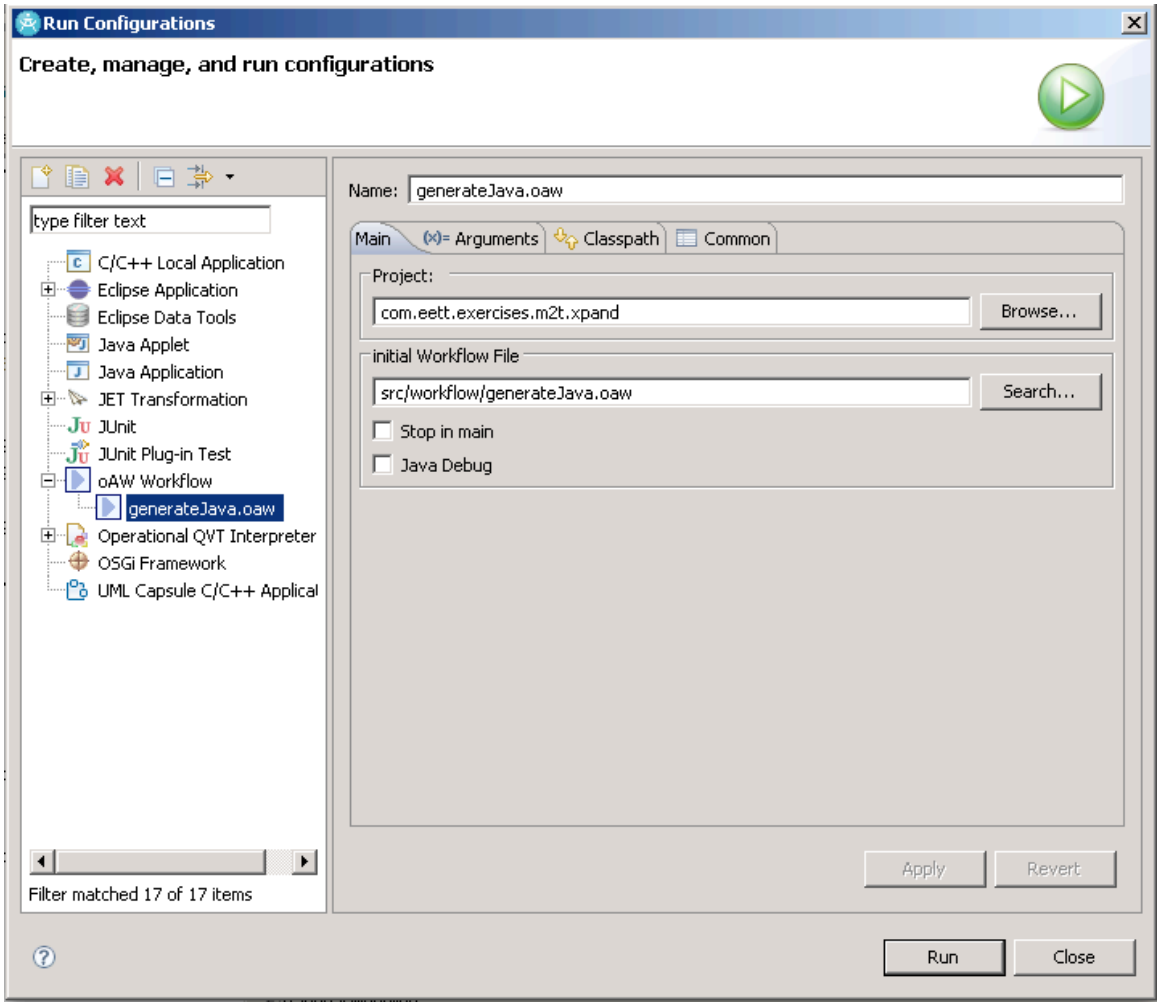
Change the model property to be the model you will test with. Note that you can also define these properties in a separate file.

```
<property name='baseDir' value='./'/>
<property file='${baseDir}/my.properties'/>
```

Change <component class=”org.openarchitectureware.xpand2.Generator”> element to be as shown below. This points to our Java metamodel and the transformation file that we renamed. The last part is a post-processing step that makes the generated Java look good.

```
<!--  generate code -->
<component class="org.openarchitectureware.xpand2.Generator">
    <metaModel id="javaMM" class="oaw.type.emf.EmfMetaModel">
        <metaModelPackage
            value="org.eclipse.emf.java.JavaPackage" />
    </metaModel>
    <expand
        value="template::GenerateJava::main FOR model" />
        <outlet path="${src-gen}" >
            <postprocessor
class="org.openarchitectureware.xpand2.output.JavaBeautifier" />
        </outlet>
    </component>
```

You can now create an oaw Workflow Run Configuration to execute the transformation. Select the workflow that we modified in the previous step as your initial Workflow File using the Search… button. Apply and run the workflow.



There should be a src-gen folder in your project with the generated files in it.

Augment the transformation to include generating the types contained in the JCompilationUnit, which should be JClass. This can be done by adding a new rule to the transformation and calling it with the EXPAND FOREACH expression.

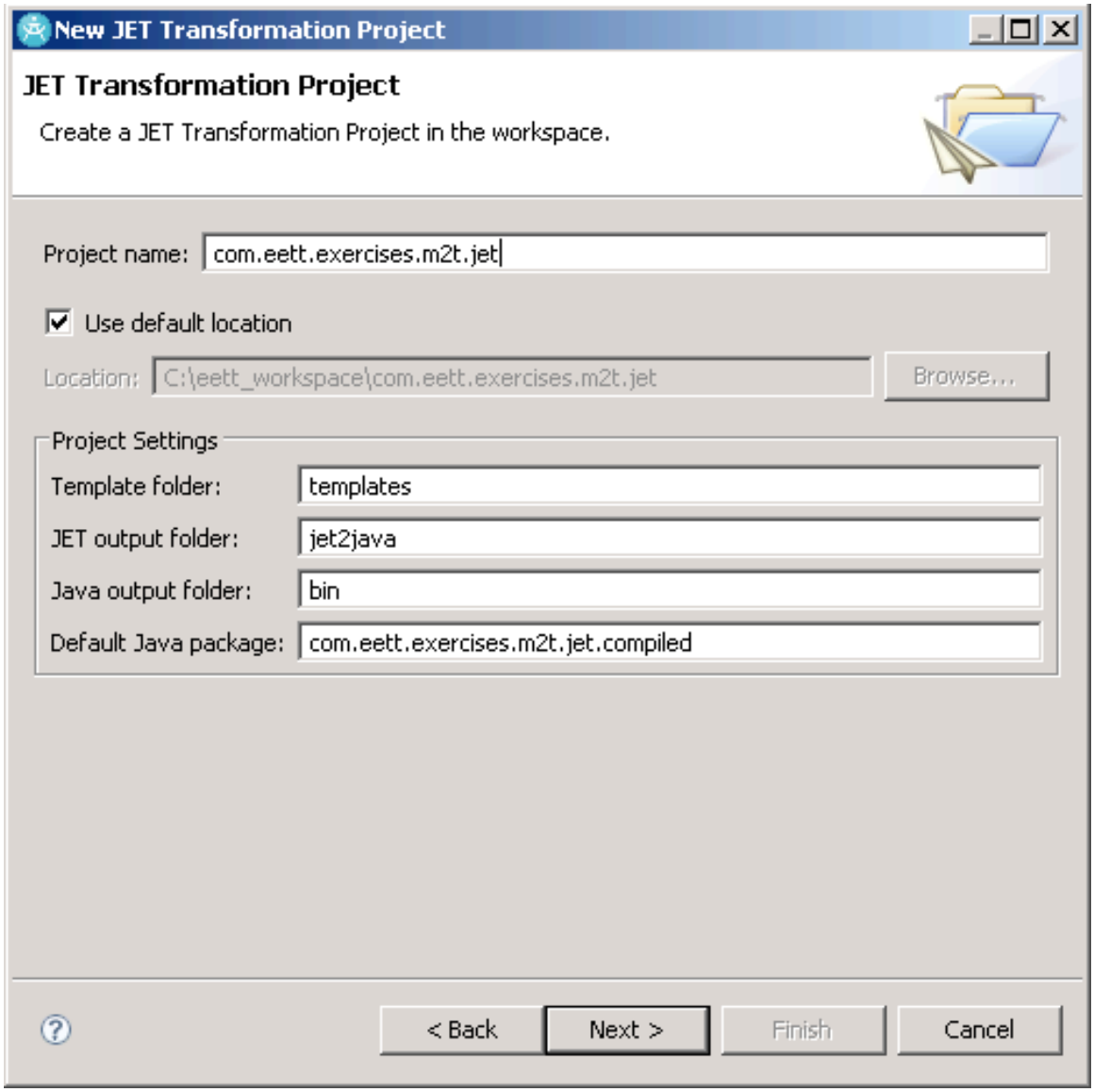
Re-run the transformation and observe the impact of your new rules.

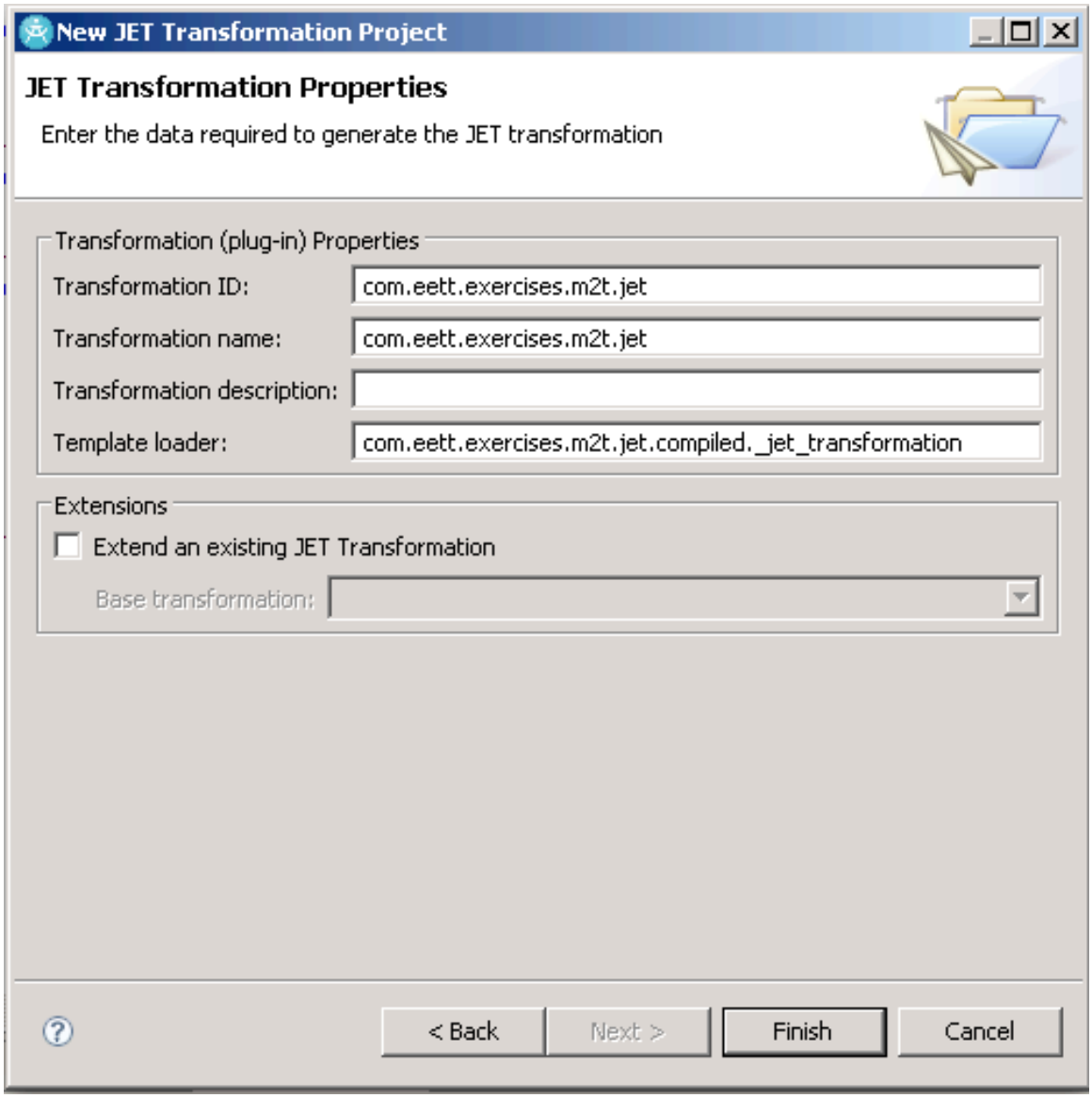
For the adventurous

- Extend the tranformation even further to include JField and JOperation for a JClass.

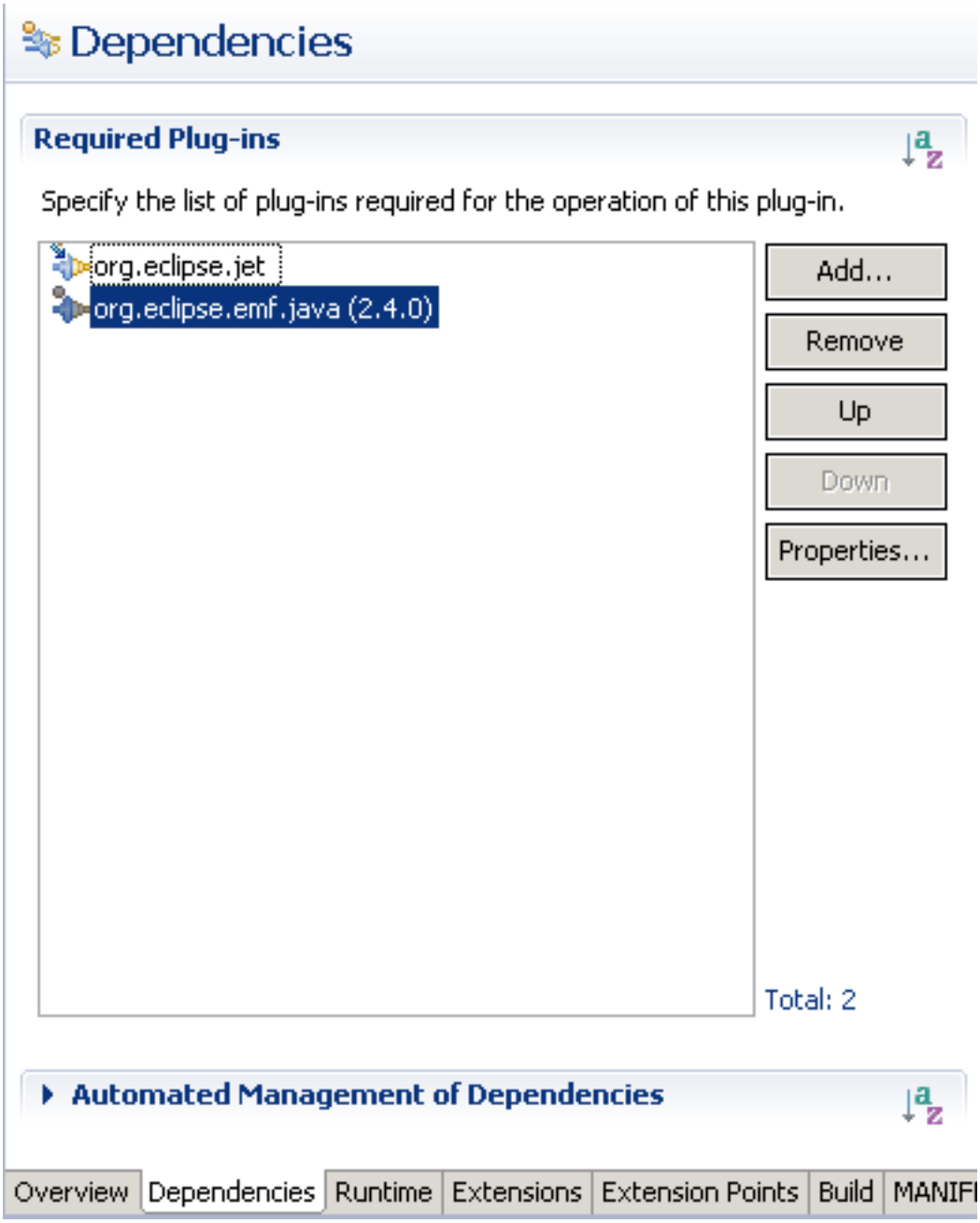
4.5 M2T with JET

In this exercise we will map a JModel into Java source. To do this we will use JET. Start by creating a new EMFT JET Transformation Project, com.eett.exercises.m2t.jet. Keep the default values for the other fields in the project wizard.

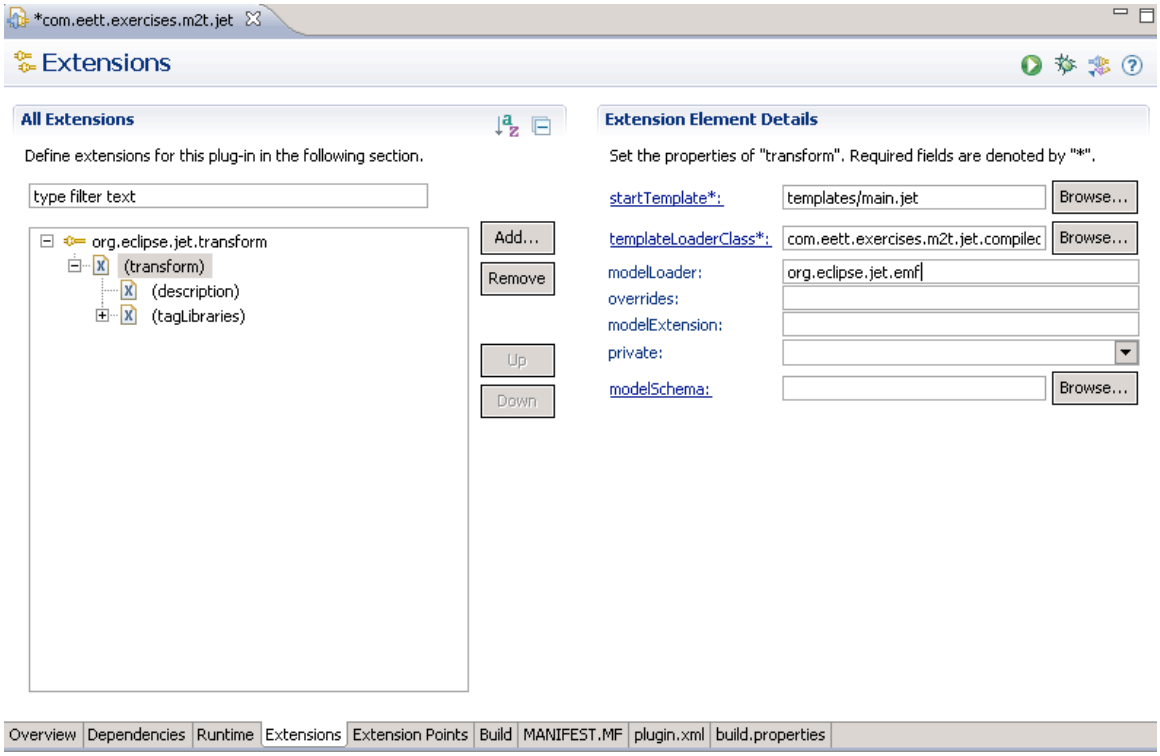



New JET Transformation Project
JET Transformation Properties
Enter the data required to generate the JET transformation
Transformation (plug-in) Properties
Transformation ID:
com.eett.exercises.m2t.jet
Transformation name:
com.eett.exercises.m2t.jet
Transformation description:
Template loader:
com.eett.exercises.m2t.jet.compiled._jet_transformation
Extensions
Extend an existing JET Transformation
Base transformation:
< Back
Next >
Finish
Cancel

Now modify the MANIFEST.MF to have a dependency on org.eclipse.emf.java.



We also need to modify the org.eclipse.jet.transform extension to specify an EMF model loader. Change to the Extensions page of the Plug-in Editor and select the (transform) element of the extension. Change its modelLoader field to be org.eclipse.jet.emf.



The JET template is named main.jet and can be found in the templates folder. We will modify it to use our metamodel. At the same time define the entry point, which sets a variable jModel, to be the root of the JModel passed in.

```
<%@jet imports="org.eclipse.emf.java.*" %>
<%@taglib prefix="ws" id="org.eclipse.jet.workspaceTags" %>
<%-- Main entry point for com.eett.exercises.m2t.jet --%>

<%-- Define variables the root element in the model --%>
<c:setVariable select="/*" var="jModel"/>
```

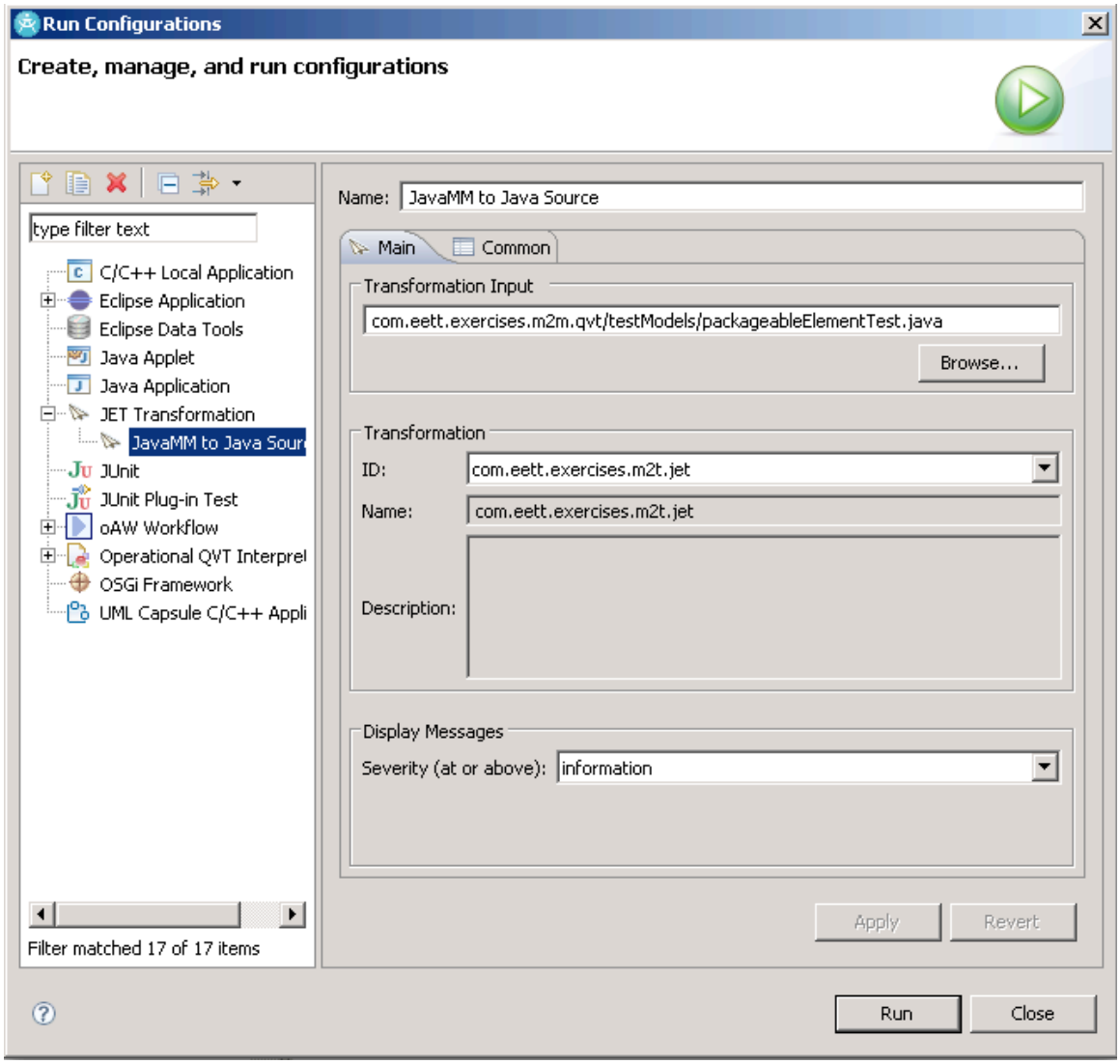
Now we will add an iterator over the JCompilationUnits (the elements attribute) in the model and write them to a file in a src-gen directory in the com.eett.exercises.m2t.jet (Note this could be a parameter to the template).

```
<c:iterate select="$jModel/elements" var="jCompilationUnit">
  <ws:project name="com.eett.exercises.m2t.jet">
    <ws:folder path="src-gen">
      <java:package name="com.eett.exercises.emf.m2t.jet">
        <java:class name="{$jCompilationUnit/@name}"
          template="templates/JCompilationUnit.java.jet"/>
       </java:package>
    </ws:folder>
   </ws:project>
</c:iterate>
```

Notice that this calls another template JCompilationUnit.java.jet that we have not created yet. So add a new JET transformation, JCompilationUnit.java.jet to the templates folder. Set the contents of the file to be the following.

```
<%@taglib prefix="ws" id="org.eclipse.jet.workspaceTags" %>
<%@taglib prefix="c" id="org.eclipse.jet.controlTags" %>

<c:iterate select="$jCompilationUnit/types" var="jClass">
public class <c:get select="$jClass/@name"/> {

}
</c:iterate>
```

You can now create a JET Transformation Run Configuration to execute the transformation. But before doing so create a new src folder called src-gen in the project. Select the transformation we just created in the ID field. Also select a Java model to test our transformation as the Transformation Input. Apply and run the transformation. The files should be generated to the src-gen folder.



Augment the transformation to include generating the types contained in the JCompilationUnit, which should be JClass. Remember that a JClass has a field that indicates whether it is an interface. Hint use the c:if tag.

Re-run the transformation and observe the impact of your new rules.

For the adventurous

- Extend the tranformation even further to include JField and JOperation for a JClass.

5 Validation Exercises

5.1 Working with Validation Framework

This exercise will perform model validation on our ROOM metamodel using the EMF validation framework. More specifically, it will create an EValidator implementation that delegates to the validation framework, to provide user-demand "batch mode" validation from an EMF editor.

5.2 Constructing a Batch Model Constraint

A model constraint is a subclass of the AbstractModelConstraint that overrides the validate() method. The validate method has the task of taking the input from the validation context returning either a ctx.createSuccessStatus() or ctx.createFailureStatus().

Create a new Class NonEmptyNamesConstraint that specializes AbstractModelConstraint, in the com.eett.exercises.validation package.

Override the validate method and add the following logic to it.

```
public IStatus validate(IValidationContext ctx) {
      EObject eObj = ctx.getTarget();
      EMFEventType eType = ctx.getEventType();

      // In the case of batch mode and not live mode.
      if (eType == EMFEventType.NULL) {
            String name = null;
            if (eObj instanceof NamedElement) {
                  name = ((NamedElement)eObj).getName();
            }
            if (name == null || name.length() == 0) {
                  return ctx.
                        createFailureStatus(new Object[]
                              {eObj.eClass().getName()});
            }
      }
      return ctx.createSuccessStatus();
}
```

We now need to add the constraint provider extension to our Plug-in Manifest. Open the plug-in editor and add an org.eclipse.emf.validation.constraintProviders extension. Add a category to the extension and set its properties to.

name	ROOM Constraints
id	com.eett.exercises.validation.constraints

Add a constraintProvider to the extension setting the package element that was created to http://www.eett.com/room/2008.

Add a constraints element to the constraintProvider and set its categories to com.eett.exercises.validation.constraints. Now add a constraint element and set its properties to.

id	com.eett.exercises.validation.NonEmptyNamesConstraint
name	Non-empty names
mode	Batch
severity	ERROR
lang	Java
class	com.eett.exercises.validation.NonEmptyNamesConstraint
statusCode	1

Modify the message element to have the following:

```
A {0} has been found to have no name specified.
```

Add three target elements to the constraint for NamedElement classes. These classes are qualified by the EPackage we specified in the package element previously.

We now need to add a context in which our constraint will execute. The primary reason for doing this is avoid constraints from different vendors being executed in the wrong context. Start by adding another extension for org.eclipse.emf.validation.constraintBindings. and add a clientContext element to it. Setting its id to com.eett.exercises.validation.roomContext and default to false.

Add a selector element to the clientContext setting its class to be com.eett.exercises.validation.ValidationDelegateClientSelector. Then create a new class in the com.eett.exercises.validation package called ValidationDelegateClientSelector and add the following to the file.

```
//NOTE: This is _NOT_ a recommended approach to writing a client selector.
//Suggested approaches:
//  -Check the resource of the EObject either by identity or by URI
//   as long as this resource is somehow unique to this application
//  -Check the identity of the resource set to ensure that it is some
//   private object
//  -Check the identity of the EObject itself to see if it belongs to
//   some private collection
//  -Check the EClass of the EObject but only if the metamodel is private
//   to this application and will not be used by other contexts
public class ValidationDelegateClientSelector
      implements IClientSelector {

      public static boolean running = false;

      public boolean selects(Object object) {
            return running;
      }
}
```

Finally add a binding element to the constraintBindings extension settings its id to be com.eett.exercises.validation.roomContext the id of the context we defined in the previous step, and the category to com.eett.exercises.validation.constraints, which we defined on the constrainProviders extension.

Your plugin.xml file should now look like the following.

```
<?xml version="1.0" encoding="UTF-8"?>
<?eclipse version="3.2"?>
<plugin>
   <extension
         point="org.eclipse.emf.validation.constraintProviders">
      <category
            id="com.eett.exercises.validation.constraints"
            name="ROOM Constraints">
      </category>
      <constraintProvider
            cache="true">
         <package
               namespaceUri="http://www.eett.com/room/2008">
         </package>
         <constraints>
            <constraint

id="com.eett.exercises.validation.NonEmptyNamesConstraint"
                  lang="Java"
                  mode="Batch"
                  name="Non-empty names"
                  severity="ERROR"
                  statusCode="1">
               <message>
                  message body text
               </message>
               <target
                     class="NamedElement">
               </target>
            </constraint>
         </constraints>
      </constraintProvider>
   </extension>
   <extension
         point="org.eclipse.emf.validation.constraintBindings">
      <clientContext
            default="false"
            id="com.eett.exercises.validation.roomContext">
         <selector

class="com.eett.exercises.validation.ValidationDelegateClientSelector
">
         </selector>
      </clientContext>
      <binding
            category="com.eett.exercises.validation.constraints"
            context="com.eett.exercises.validation.roomContext">
      </binding>
   </extension>
</plugin>
```

3.3 Executing the constraint

To be able to execute the constraint add an action to the ROOM Editor to invoke constraints. Refer to the Query and Transformation for guidance on doing this. The code to execute the is the following:

```
ValidationDelegateClientSelector.running = true;

IBatchValidator validator =
(IBatchValidator)ModelValidationService.getInstance()
     .newValidator(EvaluationMode.BATCH);
validator.setIncludeLiveConstraints(true);

IStatus status = validator.validate(selectedEObjects);
ValidationDelegateClientSelector.running = false;
```

The first part of this code snippet enables the latch so that the validation service will determine that the provided EObjects belong to our client context. We requested a batch validation and asked that the batch validator include live validation constraints because live validation constraints are often written to handle the batch validation case. Finally, we validate the selected EObjects and are given back the status of the validation.