The Object Teams Development Tooling: A high fidelity extension of the JDT

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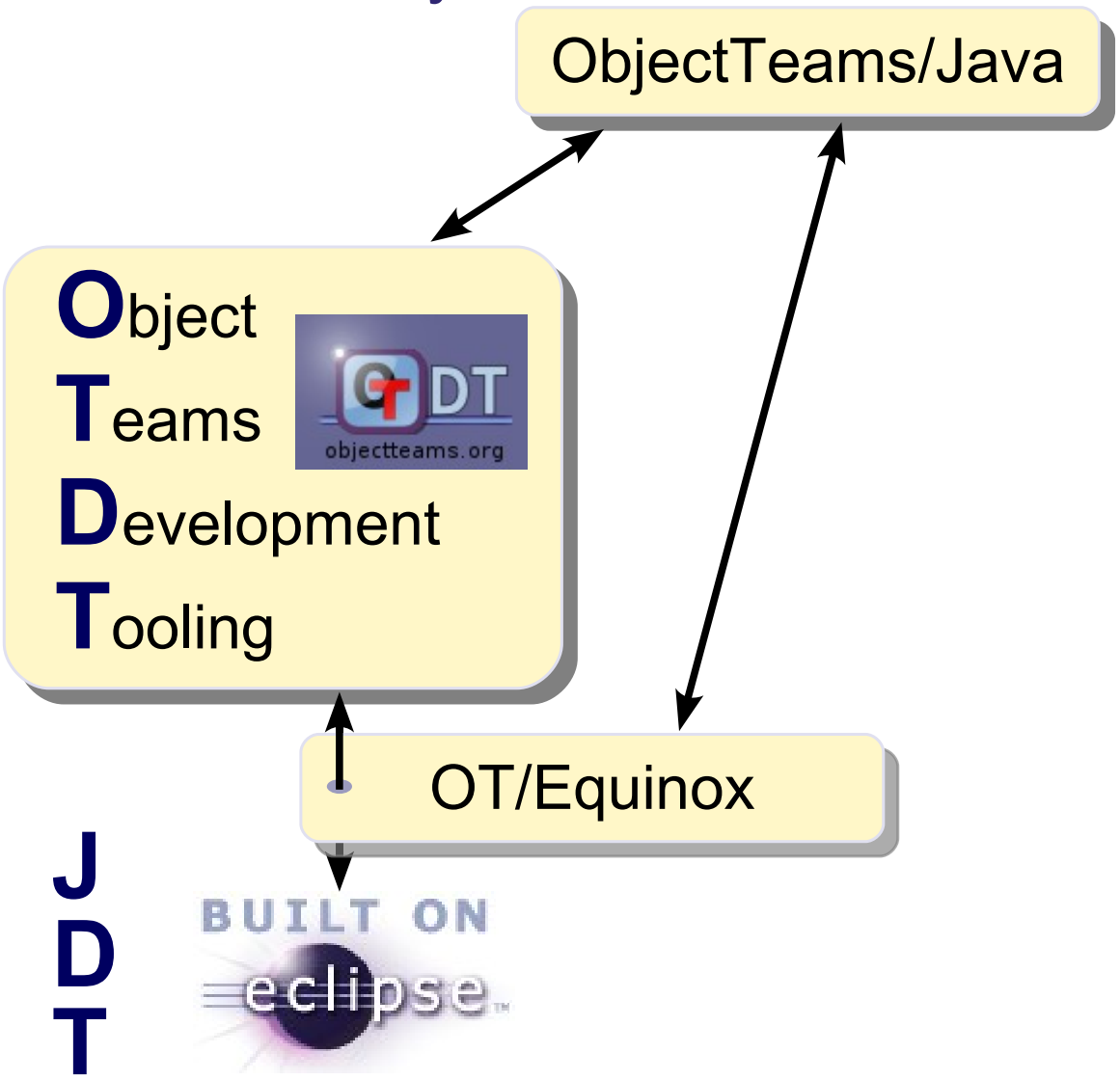
The Characters in this Play

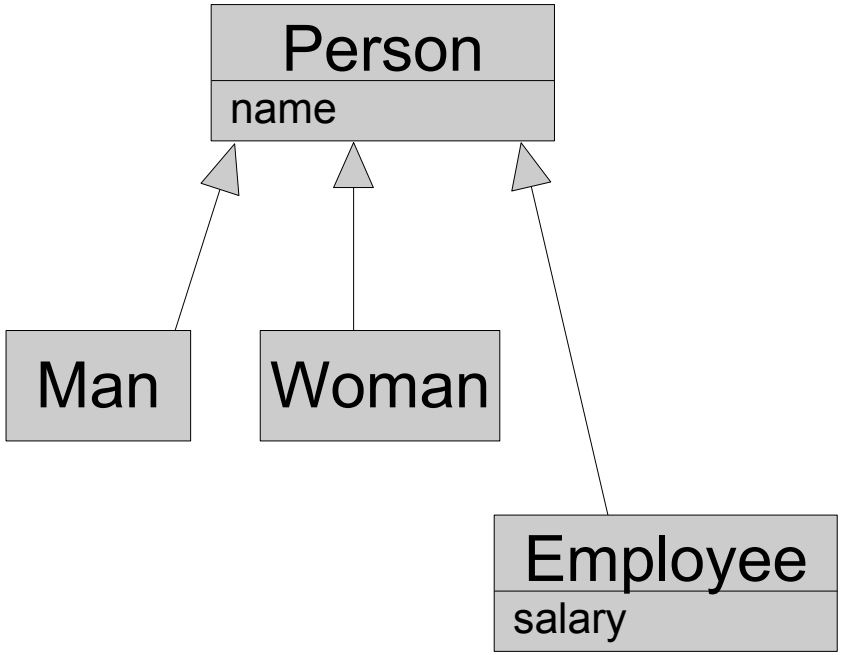


OO is not the end of language development

- E.g., **inheritance** is great, but ...

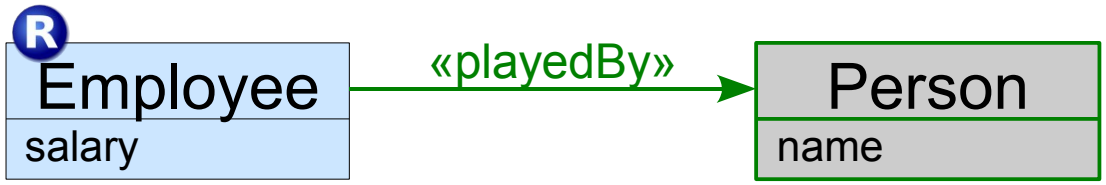
  A text book example:

  - A man/woman **is a** person, OK
  - An employee **is a** person, OK?
    - Born as an employee?
    - Dying when loosing the job?
    - Several jobs, yet only one salary?

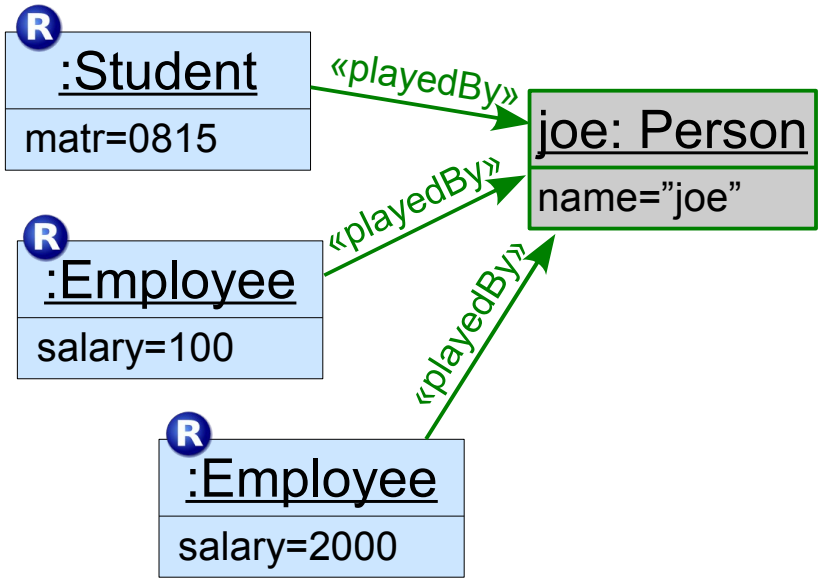


- Whats wrong with inheritance?
  - Missing “become”, “quit” ☹
  - Can't duplicate fields ☹
  - Employee & Person = 1 instance 😐
- Can we do better?
  - Yes:
  - Employee is a Role played by a Person

playedBy relationship



- Advantages:
  - **Dynamism**:
    roles can come and go
    (same base object)
  - **Multiplicities:**
    one base can play several roles
    (different/same role types)
- Is this completely new?
  - No, has been around >15 years
  - **playedBy** is similar to **extends**
  - how similar?



Comparing at a closer look

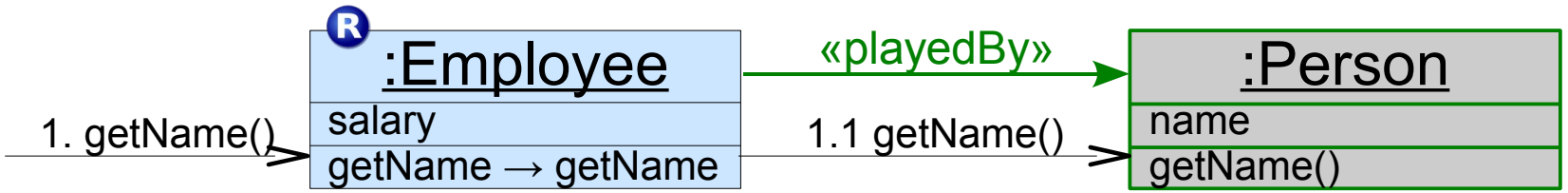
- Inheritance
  - Import / acquisition
    - **dispatch sub → super**
  - Overriding
    - **dispatch super → sub**
  - Subtype polymorphism
    - **substitutability**

?

- Role Playing

?

Import in OT/J:



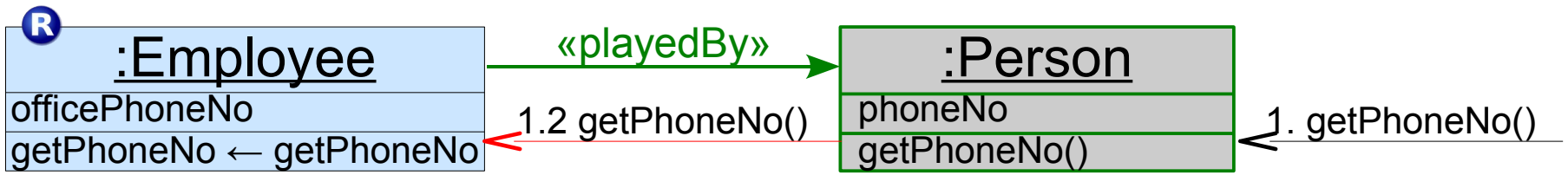
- A **callout method binding** ...

```
String getName() -> String getName();
```

... declares that calls to the role should be **forwarded** to its base

- ... can use different names on role / base sides
- ... can adjust signatures
  - implicitly: discard unused values
  - explicitly: parameter mappings

Overriding in OT/J:



- A **callin method binding** ...

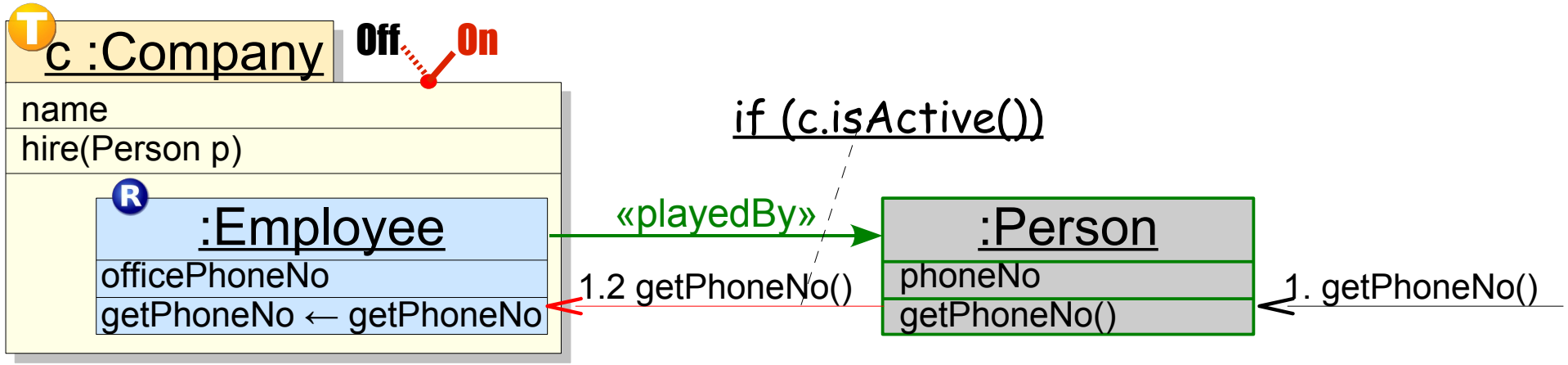
```
String getPhoneNo() <- replace String getPhoneNo();
```

... declares that calls to the base should be **intercepted** by its role

- ... can use different names on role / base sides
- ... can adjust signatures
  - implicitly: discard unused values
  - explicitly: parameter mappings
- ... comes in one of three flavors: `before`, `replace` or `after`

"... when (s)he is in the office ..."

- *How do you know?*
- **Roles depend on context**
- In OT/J contexts are reified as **Teams**
  - roles are inner classes of a **team class**
  - role instances are inner instances of a **team instance**
- Each team instance can be **(de)activated**
  - (several mechanisms: globally, per thread, implicitly, temporarily ...)



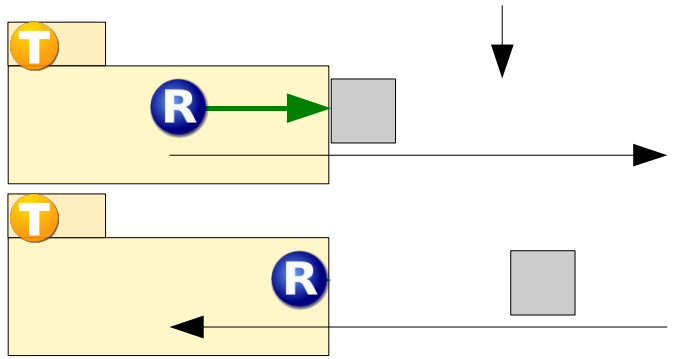
Substitutability?

- Are the following assignments legal?

```
   Employee emp= ...
   Person person= ...
1. person= emp;          // legal?
2. emp= person;          // legal?
```

Normally not, but...

- *Idea: roles live (usually) only within the team*
- When a role object **leaves** the team
  - it is **lowered** to its base
- When a base object **enters** a team
  - it can be **lifted** to a role



Comparison

- Inheritance
  - Import / acquisition
    - **dispatch sub → super**
  - Overriding
    - **dispatch super → sub**
  - Subtype polymorphism
    - **substitutability**
      - **pass an instance of sub class where the super class is expected**
- Role Playing
  - Import / acquisition
    - **dispatch role → base**
  - Overriding
    - **dispatch base → role**
  - Translation polymorphism
    - lowering role → base
    - lifting base → role
    - **two-way substitutability!**

Summary ObjectTeams/Java

- Role playing combines the powers of inheritance with
  - **Dynamism**:
    roles can come and go (same base object)
  - **Multiplicities:**
    one base can play several roles (different/same role types)
- Teams
  - **encapsulate** a set of interacting roles
  - team **activation** controls the effect of all contained **callin** bindings
  - create **larger structures** *(stacking / nesting / layering)*

Tooling for ObjectTeams/Java

- Goal: “A **high-fidelity** extension of the JDT”
  - The same quality (code & user experience)
  - Unrestricted Java-development
  - Seamless support for specifics of OT/J
- Need to cover (minimum):
  - Compiler
  - Run/Debug
  - Help
  - Integration with PDE
  - Editor
  - Code Assist
  - Refactoring
  - Wizards
  - Structure Viewers
  - Search / Call Hierarchy
- Goal: “A high-fidelity **extension** of the JDT”
  - Maximum reuse
  - Maintainable
  - Evolvable

Working with the OTDT

<DEMO 1> Summary:

- Run — as Object Teams Application
  - configuration — instantiate & activate a Team
- Wizard: — created role with `playedBy`
- Editor — seamlessly highlight etc.
- Compiling — seamlessly: incremental, eager ...
- Code assist — create OT/J elements
apply std. assists to OT/J
- Help! — link problems to language definition

Working with the OTDT

<DEMO 1> Summary:

- Run
  - configuration
- Wizard:
- Editor
- Compiling
- Code assist
- Help!

- Seamless integration
  -  Object Teams Runtime Environment
  -  Run as Object Teams Application
- Additional configuration
  -  Team Activation

Working with the OTDT

<DEMO 1> Summary:

- Run
  - configuration
- Wizard:
- Editor
- Compiling
- Code assist
- Help!

- Project creation
  - Object Teams Project
  - Object Teams Plugin Project
- Class creation
  - Team
  - Role playedBy Base
    - inline
    - role file

Working with the OTDT

<DEMO 1> Summary:

- Run
  - configuration
- Wizard:
- Editor
- Compiling
- Code assist
- Help!

- Syntax highlighting
  - includes other views like Compare
- Semantic highlighting
- Navigation
  - F3 everywhere!
  - Ctrl-O Ctrl-O
  - Callin markers
  - etc.

Working with the OTDT

<DEMO 1> Summary:

- Run
  - configuration
- Wizard:
- Editor
- Compiling
- Code assist
- Help!

- Full Java 5 support
- Incremental compilation
- Eager & partial compilation
  - sophisticated error recovery (content assist)
- Speed
- .java → .class
- Scoped keywords:
  - plain identifiers when used outside `team`

Working with the OTDT

<DEMO 1> Summary:

- Run
  - configuration
- Wizard:
- Editor
- Compiling
- Code assist
- Help!

- Completion
  - OT/J `keywords`
  - create/complete method bindings (callout/callin)
  - support std. completions in OT/J code, too. *(work in progress)*

Working with the OTDT

<DEMO 1> Summary:

- Run
  - configuration
- Wizard:
- Editor
- Compiling
- Code assist
- Help!

- Quick Fix
  - modifier problems
    - class, method, method binding
  - learn about special OT/J features
  - type errors
  - coding style
  - adapt JDT quick fixes to handle OT/J elements/rules, too:
    - suppress warnings, create method, organize imports

Working with the OTDT

<DEMO 1> Summary:

- Run
  - configuration
- Wizard:
- Editor
- Compiling
- Code assist

- Help!

- New language – new error messages
  - *"What did I do wrong??"*
  - Let us tell you.
  - Go to Language Definition
    - precise links
    - comprehensive
    - single source: XML → {PDF, XHTML (x2)}
- Tutorial
- Code Samples
- Developers' Guide

Debug

<DEMO 2> Summary:

- Stepping — showing the right code
- Debug View — tell the user what's happening
- Team Activation — show and manipulate program mode

Debug

<DEMO 2> Summary:

- Stepping
- Debug View
- Team Activation

- Source mapping
  - uses JSR 45 / SMAP
- Filter runtime library code

Debug

<DEMO 2> Summary:

- Stepping
- Debug View
- Team Activation

- Beautify special stack frames
  - revert generated names
  - use custom syntax & coloring
    - dispatch code
      {{Dispatch method foo}}
    - lifting invocations
      {{Lifting to MyRole}}
    - executing declarative bindings
      [foo <- bar]
    - base calls: almost normal method calls
      base.foo()

Debug

<DEMO 2> Summary:

- Stepping
- Debug View
- Team Activation

Team Monitor View

- derived from Variables view
- all known team instances:
  - active
  - implicitly active
  - inactive

interactively change activation

- switch program modes

Correspondence:
runtime stack traces ↔ static call hierarchies

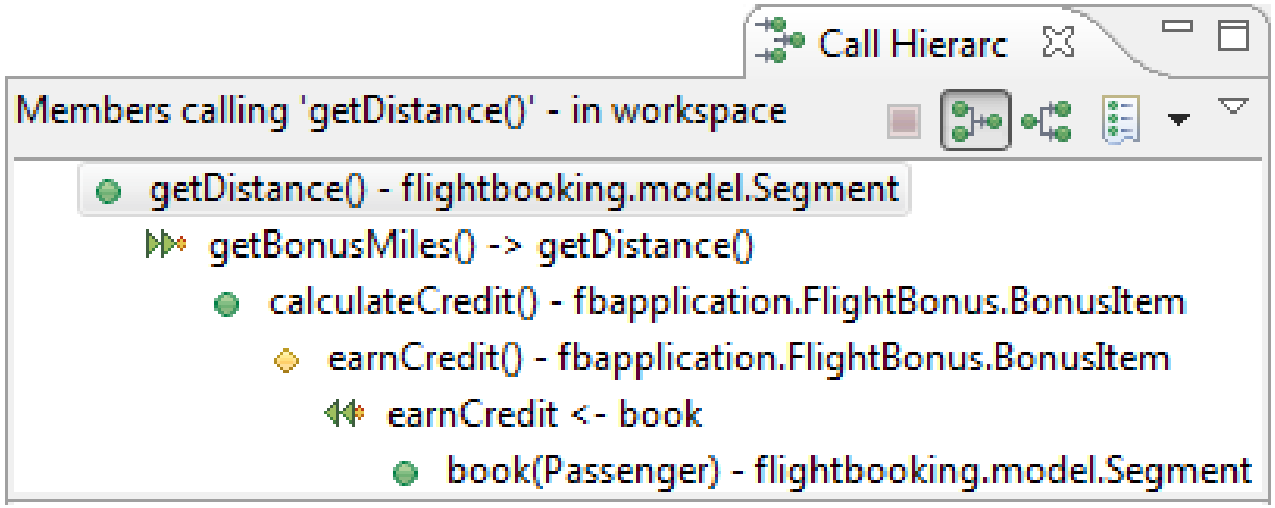
Object Teams Development Tooling

Search

- Core
  - find references within OT/J constructs
- UI
  - display found OT/J elements
  - hide generated elements
  - beautify mangled names

Call Hierarchy

- OT/J specific control flows
  - method invocations due to callout/callin method bindings
- While we're at it ...
  - control flows resulting in assignment to a given field (see https://bugs.eclipse.org/75800)



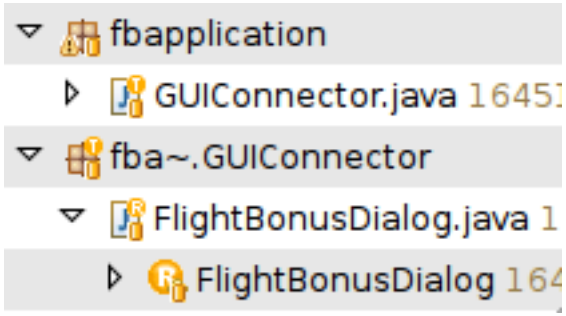
Structure Viewers

- Package explorer
- Type Hierarchy

Structure Viewers

Package explorer

- overlays for packages (package = team, containing role files)
- switch physical/logical presentation of role files ( )



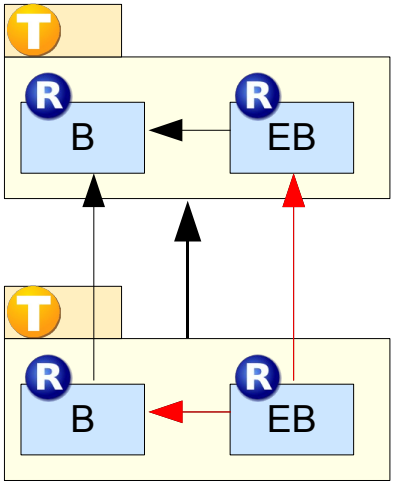
Type Hierarchy

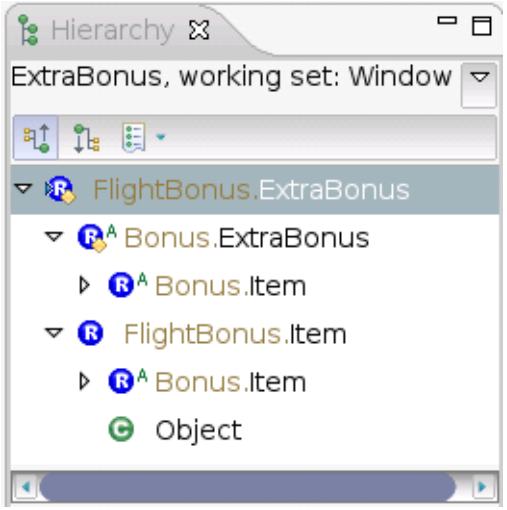
Structure Viewers

- Package explorer
- Type Hierarchy

Structure Viewers

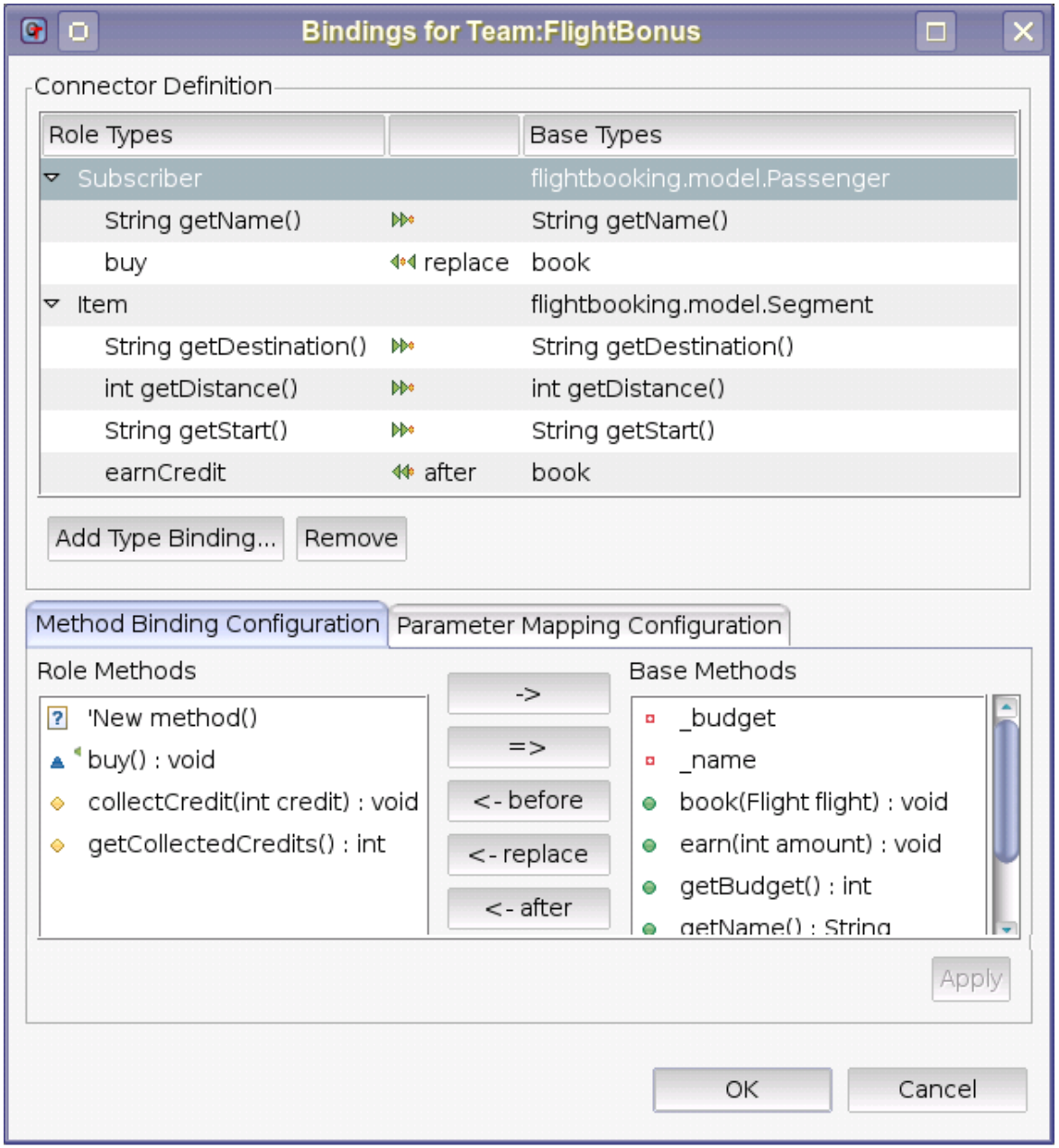
- Package explorer
- Type Hierarchy
  - Team inheritance induces new structure
    - role classes can be overridden (virtual classes)
    - overriding role implicitly inherits from previous version
    - a role may have multiple supers





Binding Editor

- Genuinely new view
- Idea: table based editing of these bindings:
  - playedBy
  - callout
  - callin
- Implemented
  - as a dialog
  - using AST rewriting



Refactoring

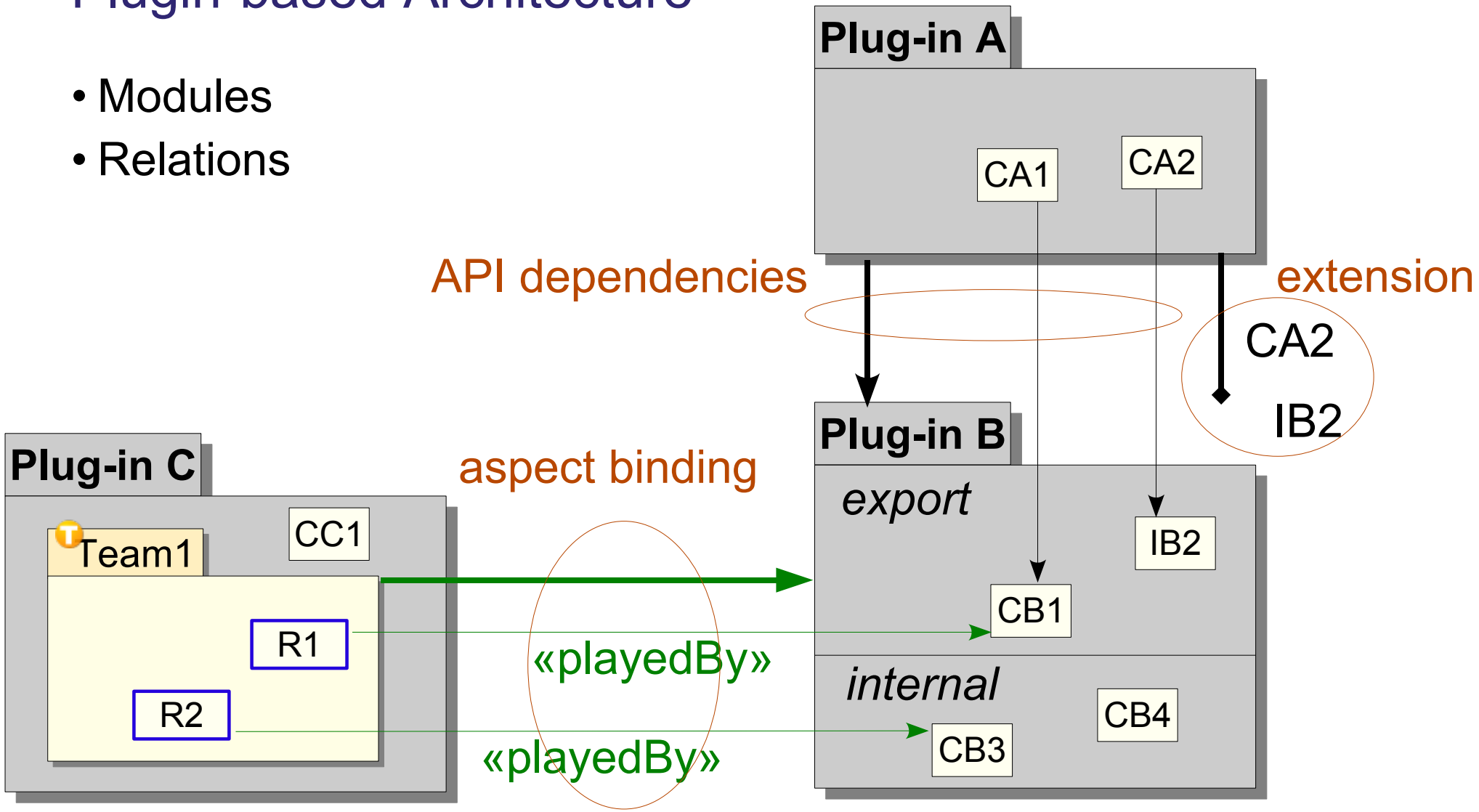
- Ensure soundness of existing refactorings
  - Java refactorings must not break OT/J code
  - done for some fundamental refactorings
    - implementation was based on JDT 3.0
    - currently only partly supported
    - *migration is work in progress*
- New refactorings
  - want to create OT/J structures by refactoring
  - *current stage: planning*

Facing real problems

- OTDT should be similar to JDT, just different
  - Difference is
    - not anticipated by JDT developers
    - nor likely to be supported by future version of the JDT
      - too many hooks needed,
      - scenarios are too specific
- "I need this hook now."
  - Copy & paste? Other ways of hacking the base?
- "My adaptation must be maintainable." – *"clean"*
  - one module per feature (and vice versa)
  - well-defined / narrow interface to existing plugins.
- That's what OT/J has been developed for!
- Our "trick":
  - Plugins written in ObjectTeams/Java

Plugin-based Architecture

- Modules
- Relations

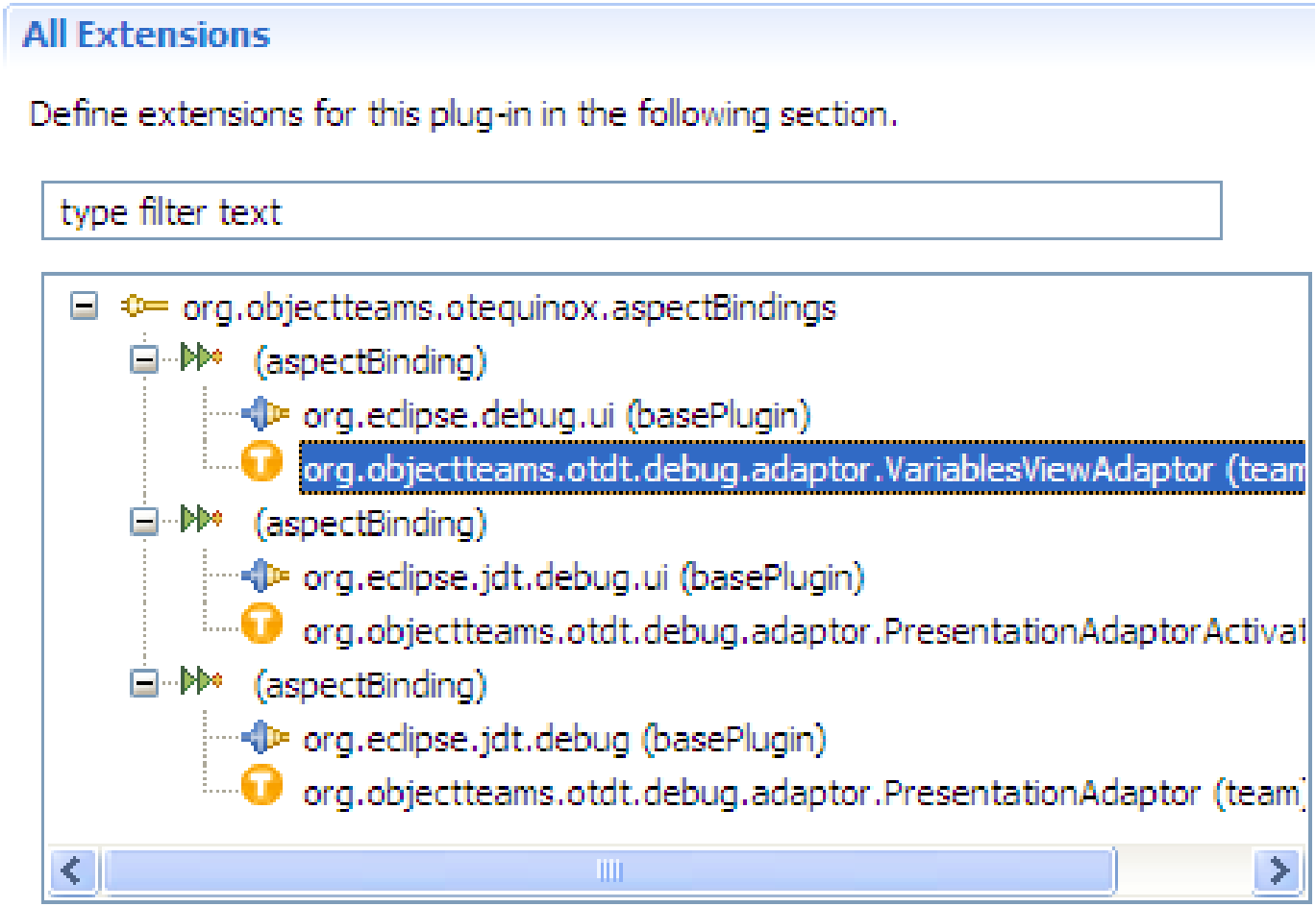


Declaring Aspect Bindings

Extendsion point `org.objectteams.otequinox.aspectBindings`

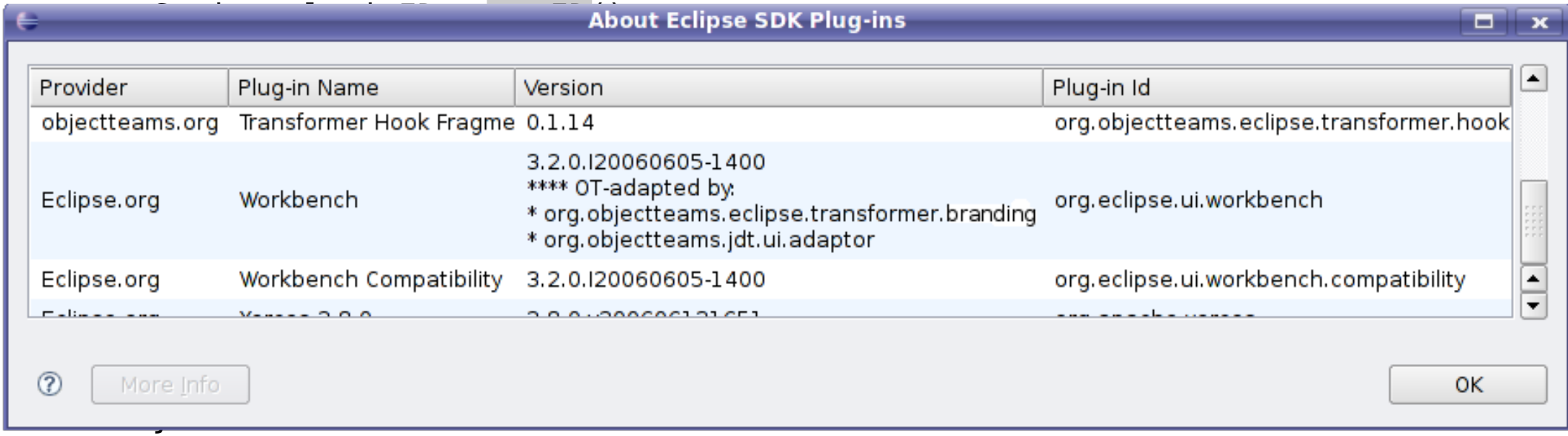
- basePlugin
- team

- Limited privileges
- Deployment
  - Instantiation
  - Activation



E.g., adapting “About Bundles”

```
public team class BrandingAdaptor {
  protected class AboutBundleAdaptor playedBy AboutBundleData
  {
    callin String getVersion() {
      String adaptationString = ""; //$NON-NLS-1$
```



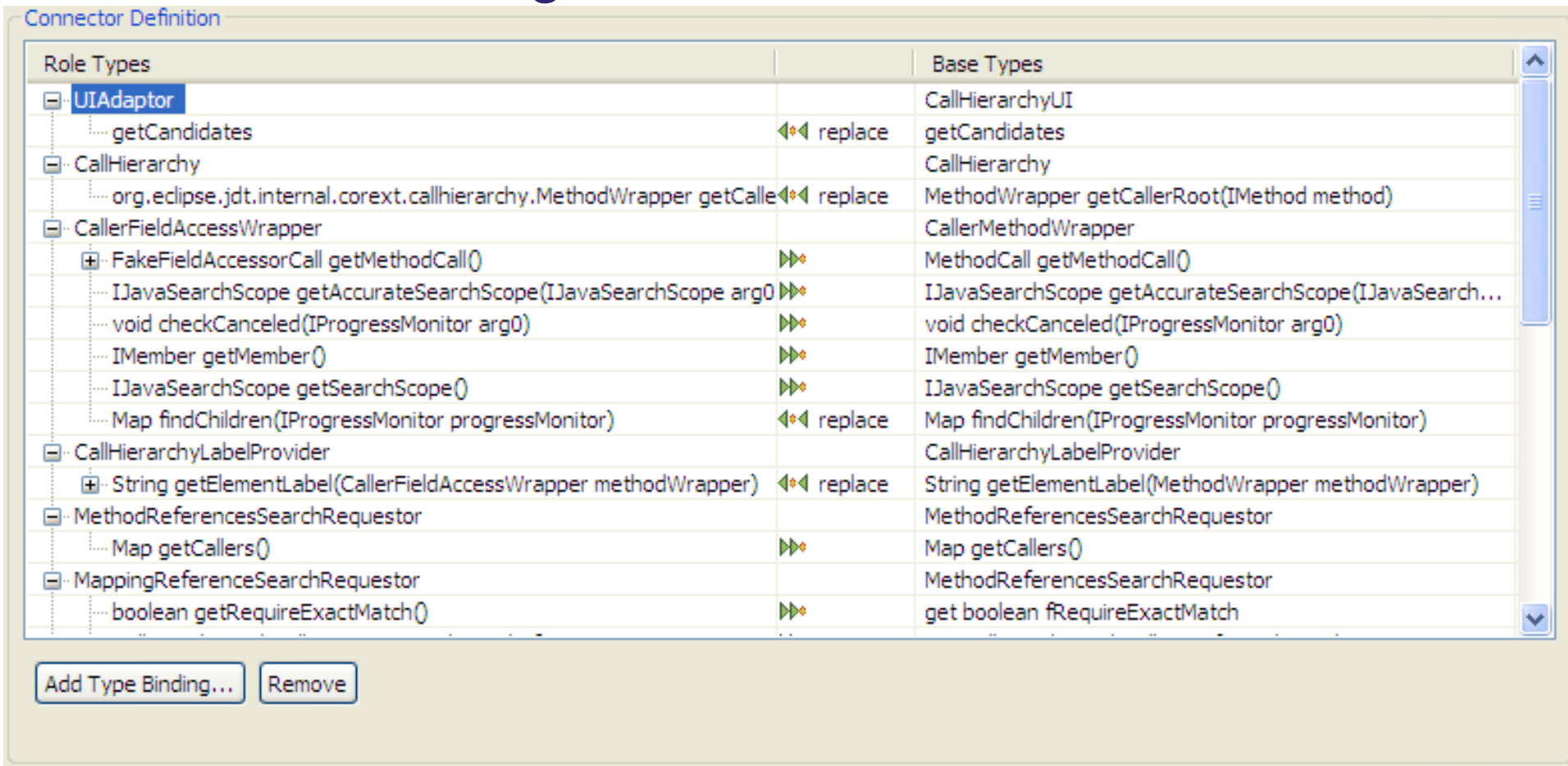

```
      return base.getVersion() + adaptationString;
    }
    String getID() -> String getId();
    getVersion <- replace getVersion;
  }
}
```

Overriding 1 single method

Typical adaptation: extend switch-case

```
protected class SuppressWarningsAdaptor playedBy SuppressWarningsSubProcessor {
  static callin void addSuppressWarningsProposal(ICompilationUnit cu, ASTNode node,
    String warningToken, int relevance, Collection<ASTRewriteCorrectionProposal> proposals)
  {
    // adding one case block to the front of the original method:
    ChildListPropertyDescriptor property= null;
    String name;
    Object baseElement;
    switch (node.getNodeType()) {
    case ASTNode.CALLIN_MAPPING_DECLARATION:
      property= CallinMappingDeclaration.MODIFIERS2_PROPERTY;
      baseElement=                                  // otj specific code here
      name=                                         // otj specific code here
      break;
    // other similar cases omitted
    default:
      // other cases are already handled by the original method.
      base.addSuppressWarningsProposal(cu, node, warningToken, relevance, proposals);
      return;
    }
    String label=                                   // otj specific code here
    ASTRewriteCorrectionProposal proposal=          // otj specific code here
    proposals.add(proposal);
  }
  addSuppressWarningsProposal <- replace addSuppressWarningsProposal;
}
```

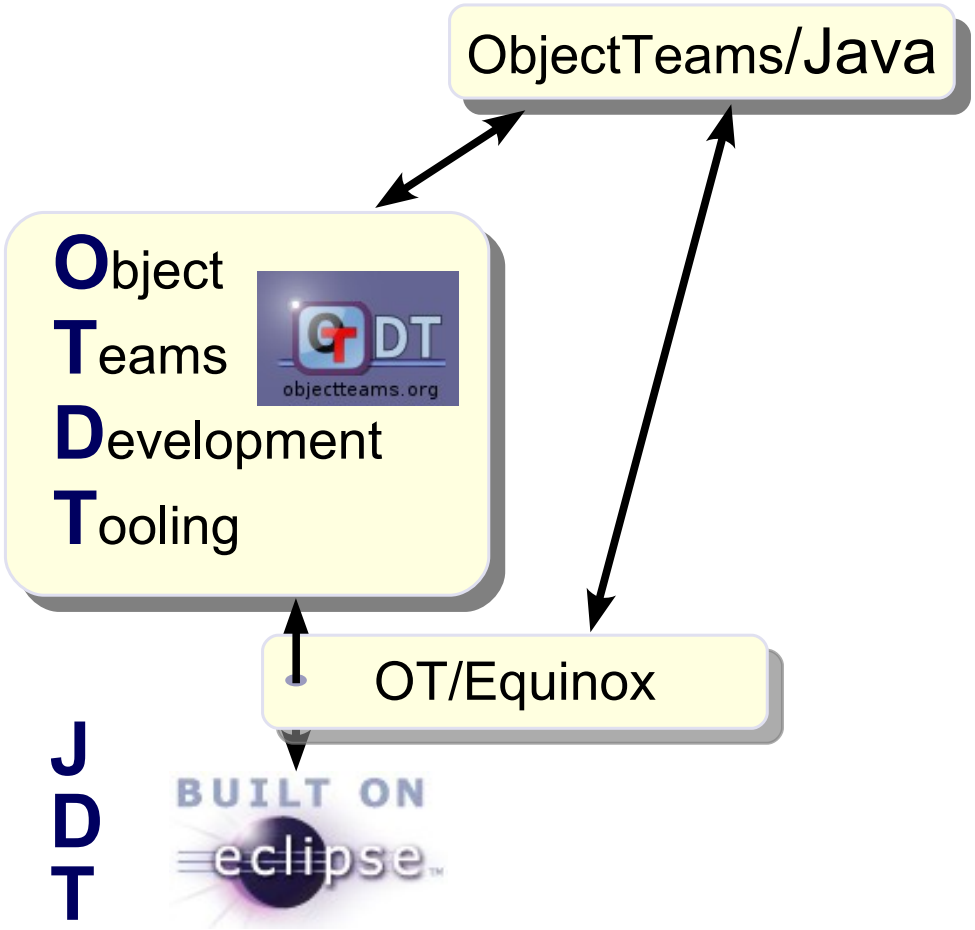

Advanced OT-Plugin



- One team encapsulates many individual adaptations.
- Adapting several plugins involves several teams.

Trailer

The way we've come



- ObjectTeams/Java
  - started in late 2001
- OTDT
  - started in 2003
  - 1.0.0 release with Callisto
- OTDT on OT/Equinox
  - since mid 2006
  - current version is 1.1.8
- OT/Equinox for non-IDE use

see you on http://www.objectteams.org/

