*Grid* programming with components:
an advanced *COMP*onent platform
for an effective invisible grid


# GCM component programming with ADL:
# *A Methodology using Grid IDE*

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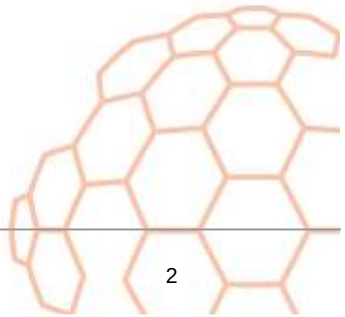
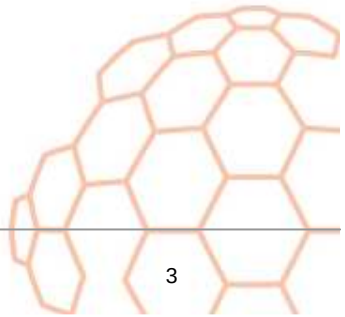
# Outline

- Background
- Motivation
- GCM Reference Implementation
- Grid IDE – Strategy
- Grid IDE – Different Views
- Using GIDE – Illustrated with an example
- Legacy Code Wrapping
- Further Work and Conclusions



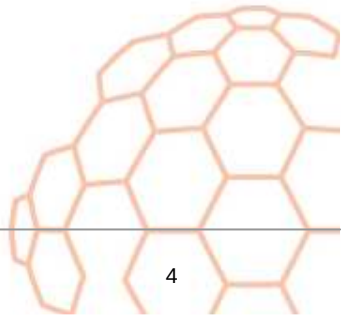
# Background: Building Grid Applications

- Proprietary middleware (Globus 1.0, Legion, Unicore, …)
  - Resources exposed through an API
  - Non interoperable !
- Object-based middleware
  - Resources exposed through distributed objects (Java, CORBA, etc.)
  - Some interoperability issues with the communication protocols (CORBA IIOP)
  - Not anymore at the top of the hype !
- Service-based middleware
  - Resources exposed through services
  - Strong support from the Industry
  - At the top of the hype !
  - Need some extensions (stateful Web services)



# Motivation

- "Grid Everywhere" and Pervasive Computing strategies demand truly dynamic software infrastructures.
- Developing Grid Applications with GCM-specific programming model requires an intuitive form of assistance
- Under GCM model, applications are considered as compositions of components
- An integrated development environment to facilitate development/composition, deployment and monitoring is essential
- GridCOMP Grid IDE (GIDE) extends the capabilities of Eclipse to support GCM-based development.

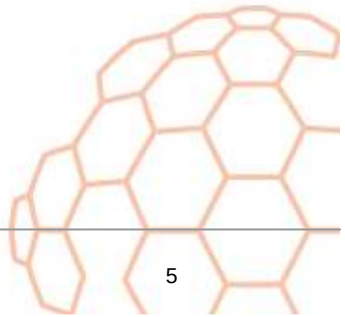


# One of the Main Research Challenges for Future Grids

**To develop the software design and development methodology of a generic component-based Grid platform for both applications and tools/systems to have a single, seamless, "invisible" Grid software services infrastructure.**

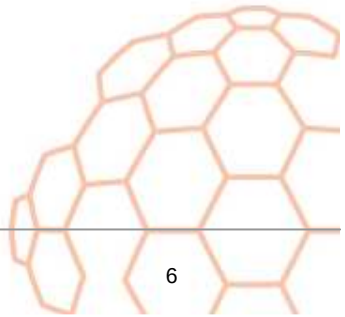
**Possible Solution:**

**Grid Component Model (GCM)**



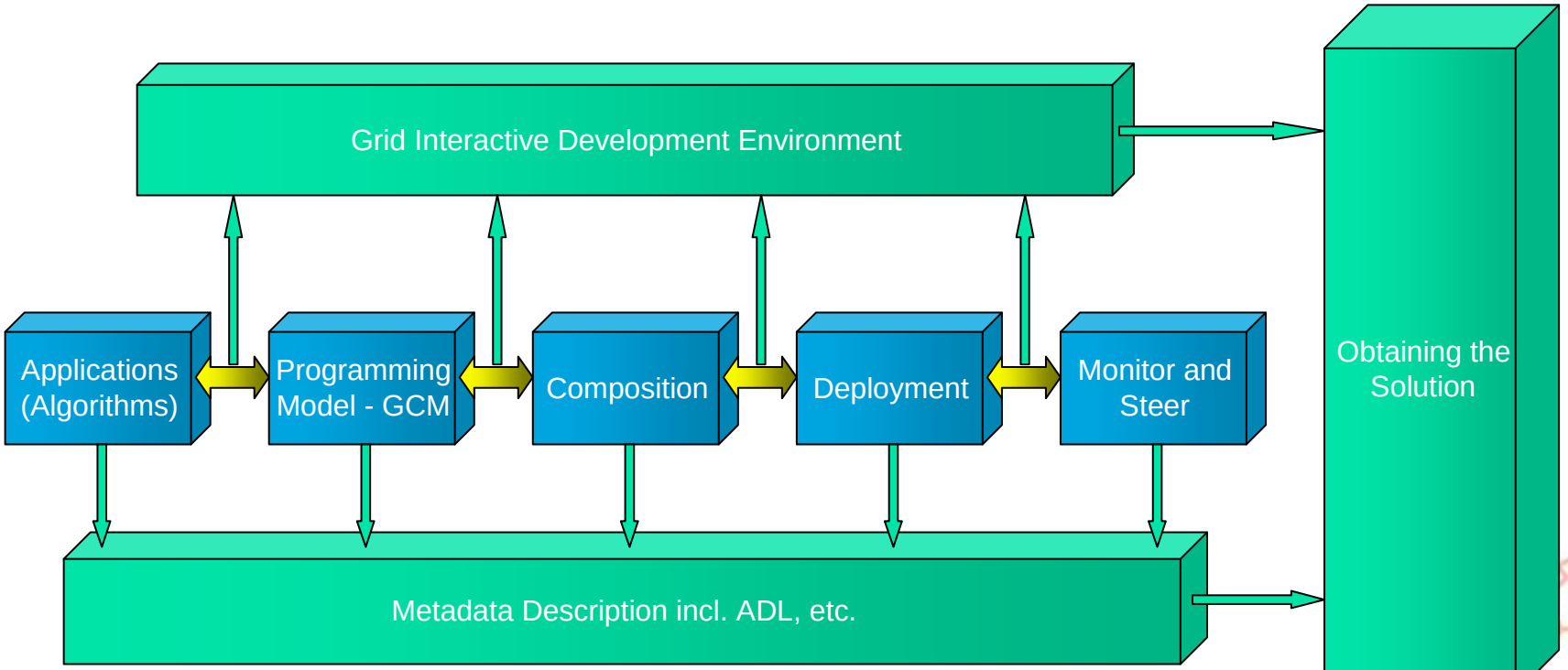
# GCM Reference Implementation

- **1 - Primitive Component Programming**
- **2 - Legacy Code Wrapping, Interoperability**
- **3 - Composition and Composites, Deployment**
- **4 – Autonomic features**
- **5 – IDE for GCM (Composition GUI, etc.)**



# GridCOMP: Component-Centric Problem-to-Solution Pipeline

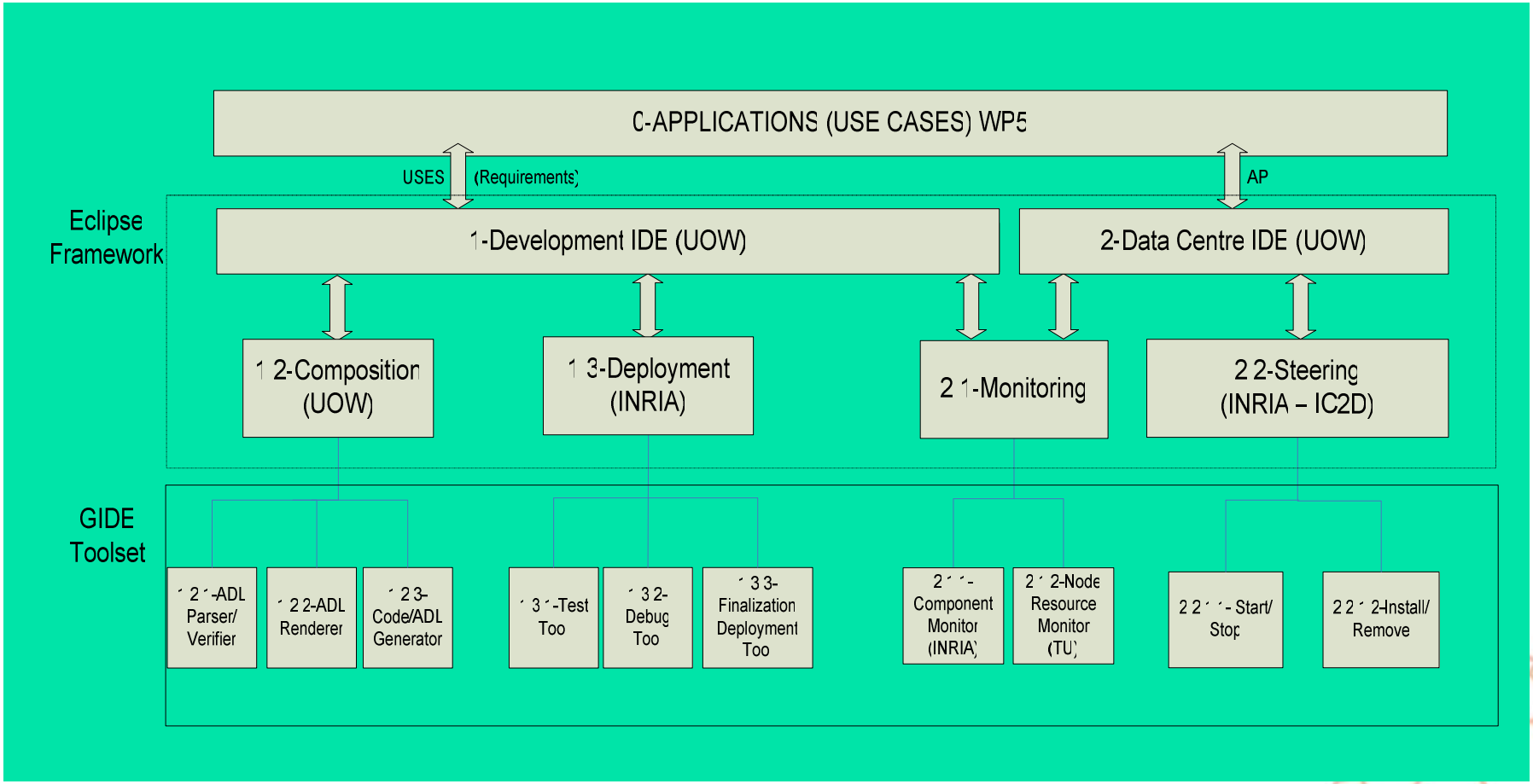
- Main issues: composition and dynamic properties –
  deployment, monitoring and steering



# Strategy: Eclipse Framework for GIDE

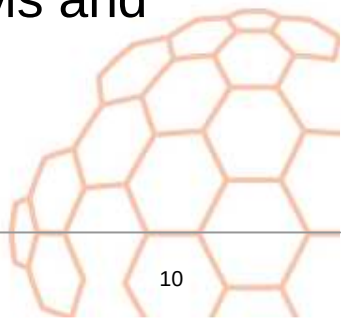
- Simplify complexity through graphical composition/tools.
- But, allowing ONLY graphical composition can be inflexible and inefficient.
- Support for 3 levels of Development.
  - Graphical Composition.
  - Based on GCM and Proactive.
  - Java.
- Seamless integration with Eclipse.
  - Widely supported. Many existing plugins (IC2D).
- “Lets not restrict developers.”

# Grid IDE Core Block Diagram



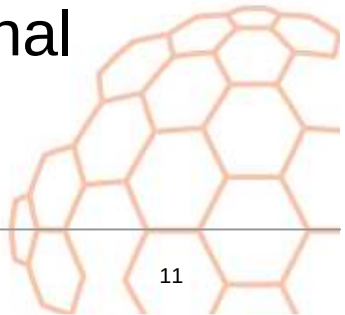
# Development Environment Design

- Composition Perspective
  - Graphical but also allow code editing.
- Deployment Perspective.
  - Drag/drop to scheduler.
  - Launch/Stop through right click actions.
- Resource Monitoring Perspective.
  - Host View
  - Resource List View.
- Component Monitoring/Steering Perspective.
  - Graphical display of Component status.
  - Relocation via drag/drop
  - IC2D already does graphical monitoring of hosts, JVMs and Active Objects.



# GIDE – An Insight into composition

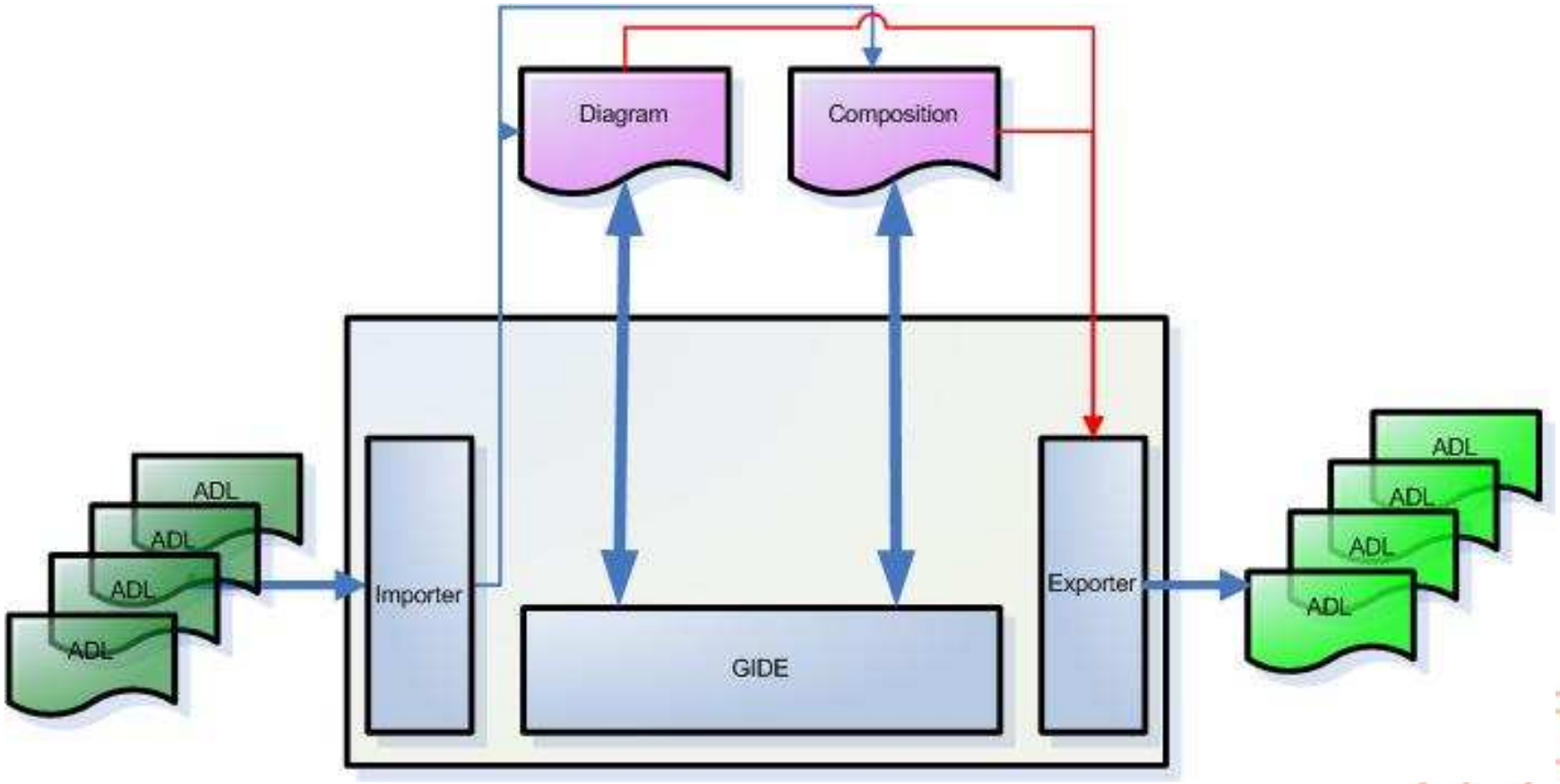
- GIDE builds on GMF for providing graphical front-end
- The IDE includes
  - Built-in ADL parser
  - Verifier
  - Diagram-generator
  - Semantic-Generator
  - ADL-exporter
- ADL files are verified, parsed and then appropriate internal representations of compositions (semantic representation) and diagrams are generated.
- GIDE delegates the user-interactions to these internal representations



# Domain model

```
<?xml version="1.0" encoding="utf-8" ?>
- <xsd:schema targetNamespace="http://perun.hscs.wmin.ac.uk/GridCOMP/gidecomposition"
    xmlns:gidecomposition="http://perun.hscs.wmin.ac.uk/GridCOMP/gidecomposition"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema"
    xmlns:ecore="http://www.eclipse.org/emf/2002/Ecore">
    <xsd:element name="Component" type="gidecomposition:Component" />
  - <xsd:complexType name="Interface">
      <xsd:attribute name="Name" type="xsd:string" use="required" />
      <xsd:attribute name="Id" type="xsd:unsignedShort" use="required" />
      <xsd:attribute name="Type" type="xsd:string" use="required" />
      <xsd:attribute name="Cardinality" type="gidecomposition:CardinalityType" use="required" />
      <xsd:attribute name="CardinalityIn" type="xsd:unsignedByte" use="required" />
      <xsd:attribute name="CardinalityOut" type="xsd:unsignedByte" use="required" />
    </xsd:complexType>
  - <xsd:complexType name="Component">
    - <xsd:sequence>
        <xsd:element name="Interfaces" type="gidecomposition:Interface"
          maxOccurs="unbounded" />
        <xsd:element ref="gidecomposition:Component" maxOccurs="unbounded" />
        <xsd:element name="Connections" type="gidecomposition:ConnectionType"
          maxOccurs="unbounded" />
      </xsd:sequence>
      <xsd:attribute name="Name" type="xsd:string" use="required" />
      <xsd:attribute name="Id" type="xsd:unsignedShort" use="required" />
      <xsd:attribute name="LastModified" type="xsd:string" use="required" />
```

# GIDE – An Insight in to composition …

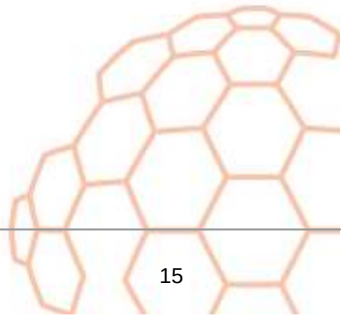


# Data Centre Environment

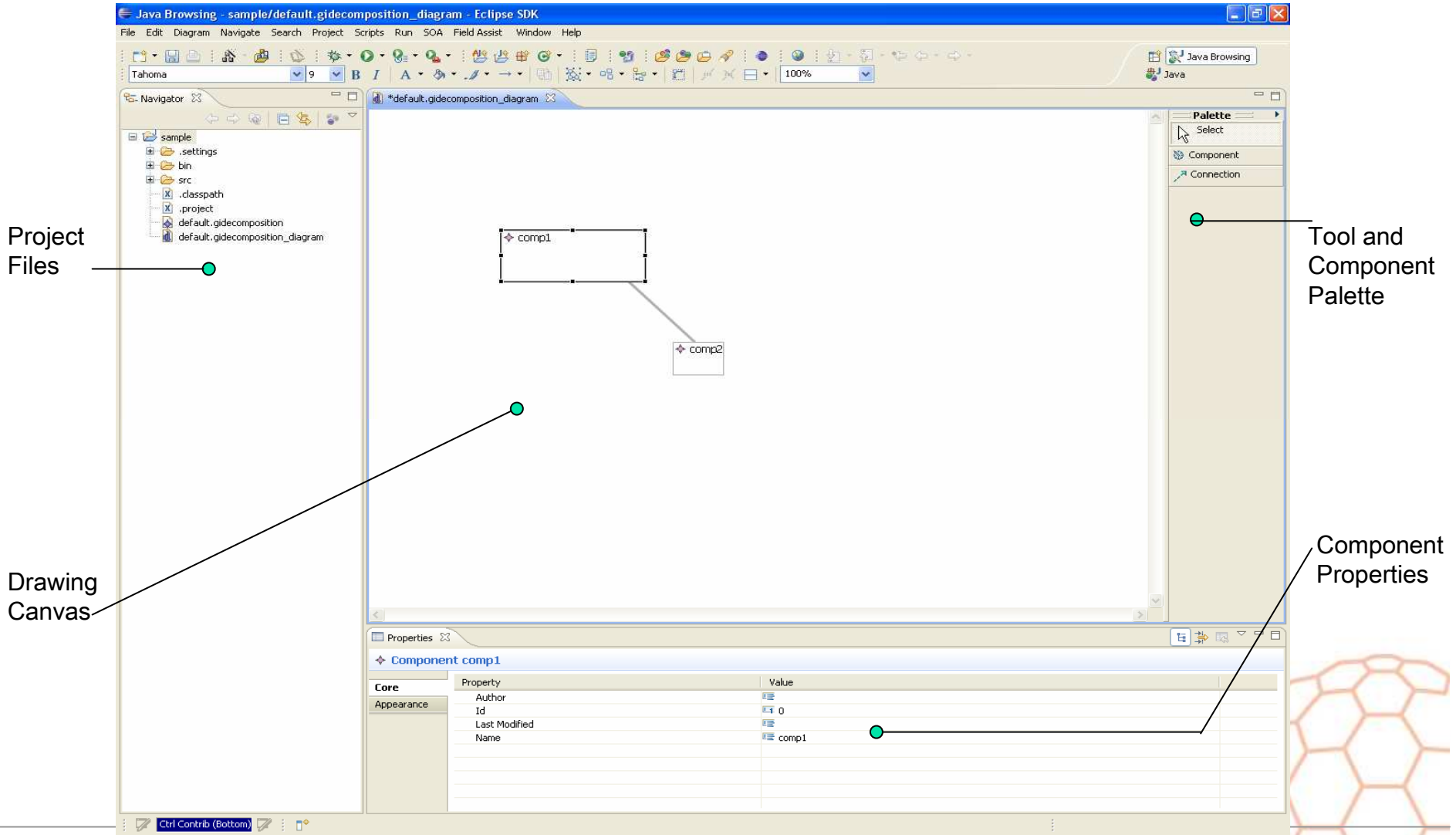
- Separate RCP application.
- Clear and fixed functional views.
  - Deploy
  - Resource Monitor
  - Component Monitor and Steer
- Restrict personalisation.
  - Data Centres have high rates of turnover.
  - High demand means generally low expertise.
- “Lets protect operators from the details.”

# Composition – An example

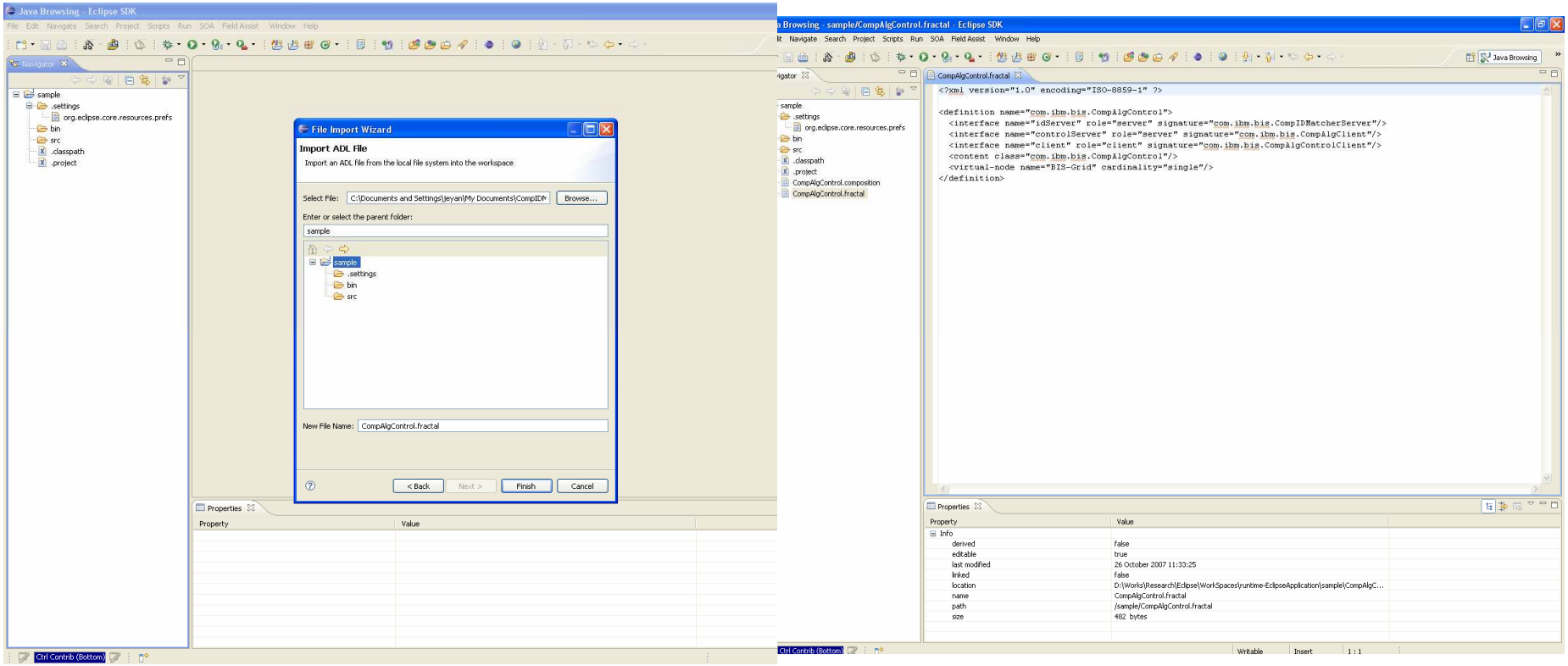
- This example builds on Use-Case 5
- The use-case include three components – two primitives and one composite
- The composition is expressed as an ADL file
- The tutorial will illustrate the general usage and then how we could import compositions from ADL files
- This is based on current version – whose features are evolving



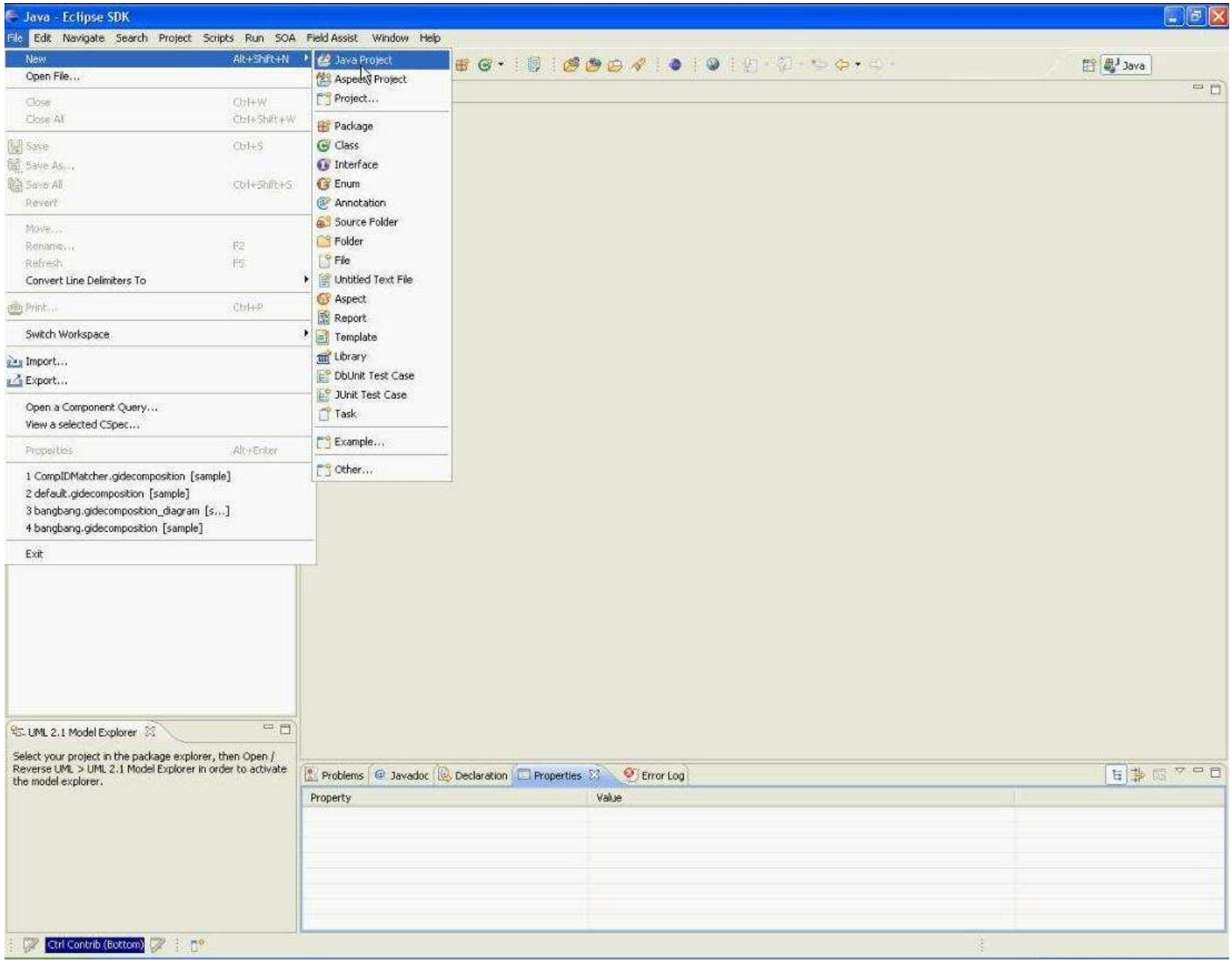
# User Interface of the Composition Editor



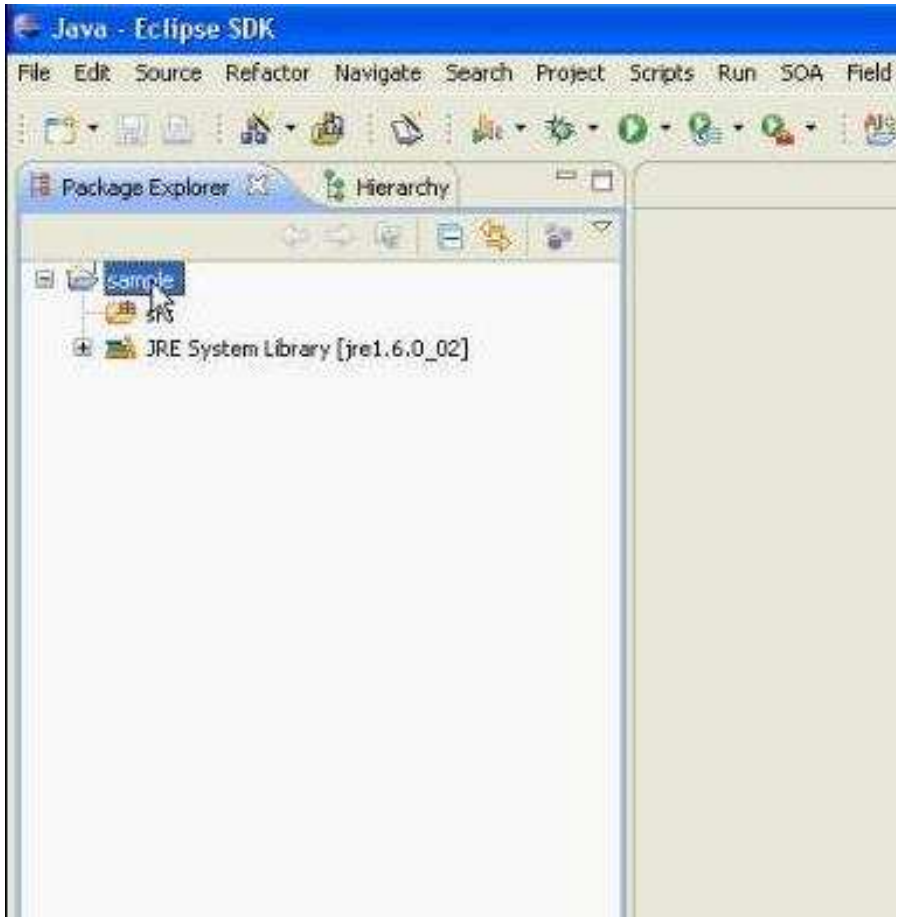
# Import and Editing Views



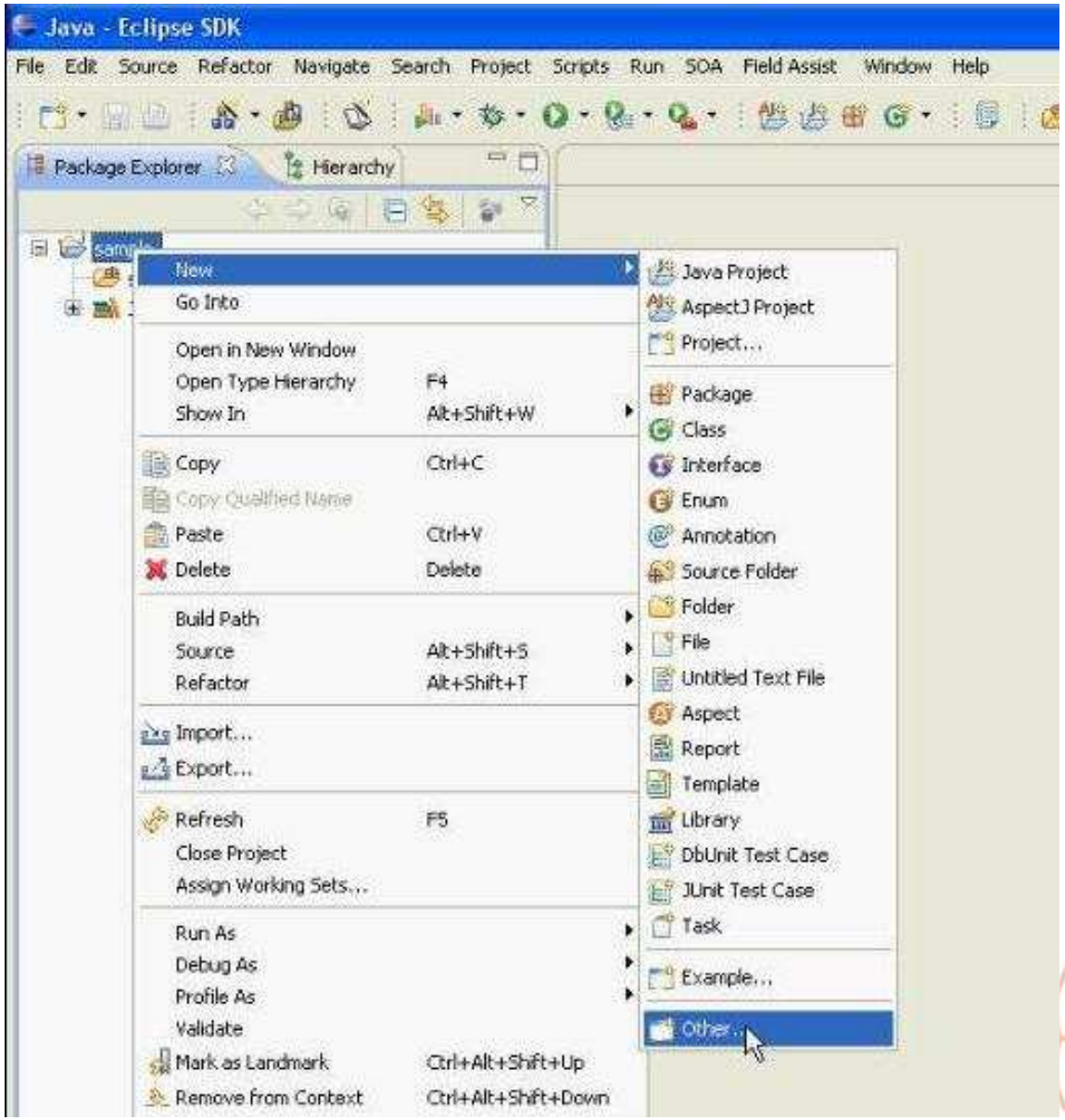
- Create a new Java Project to start with.

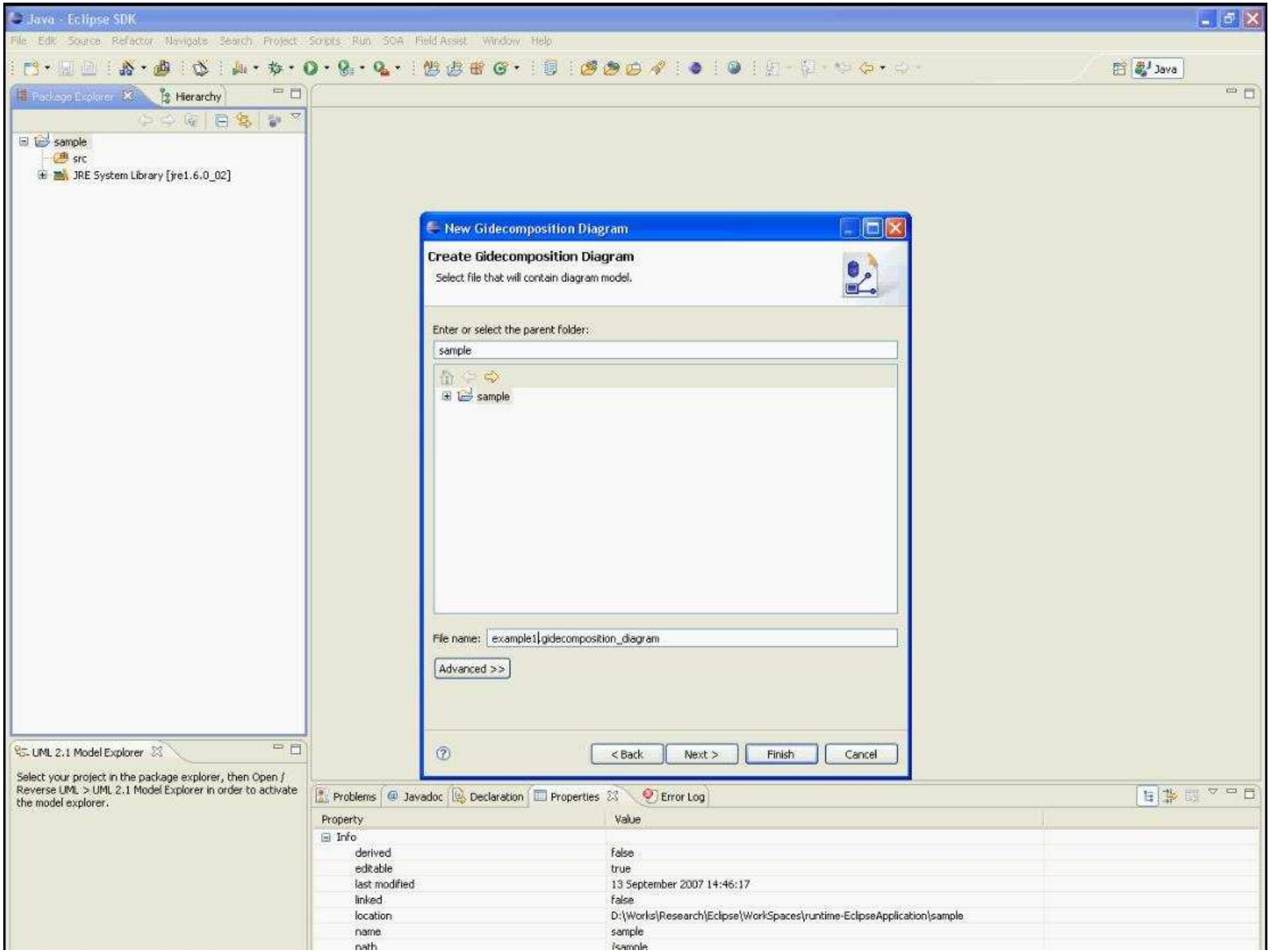


# *This should bring-in the necessary files to the project*

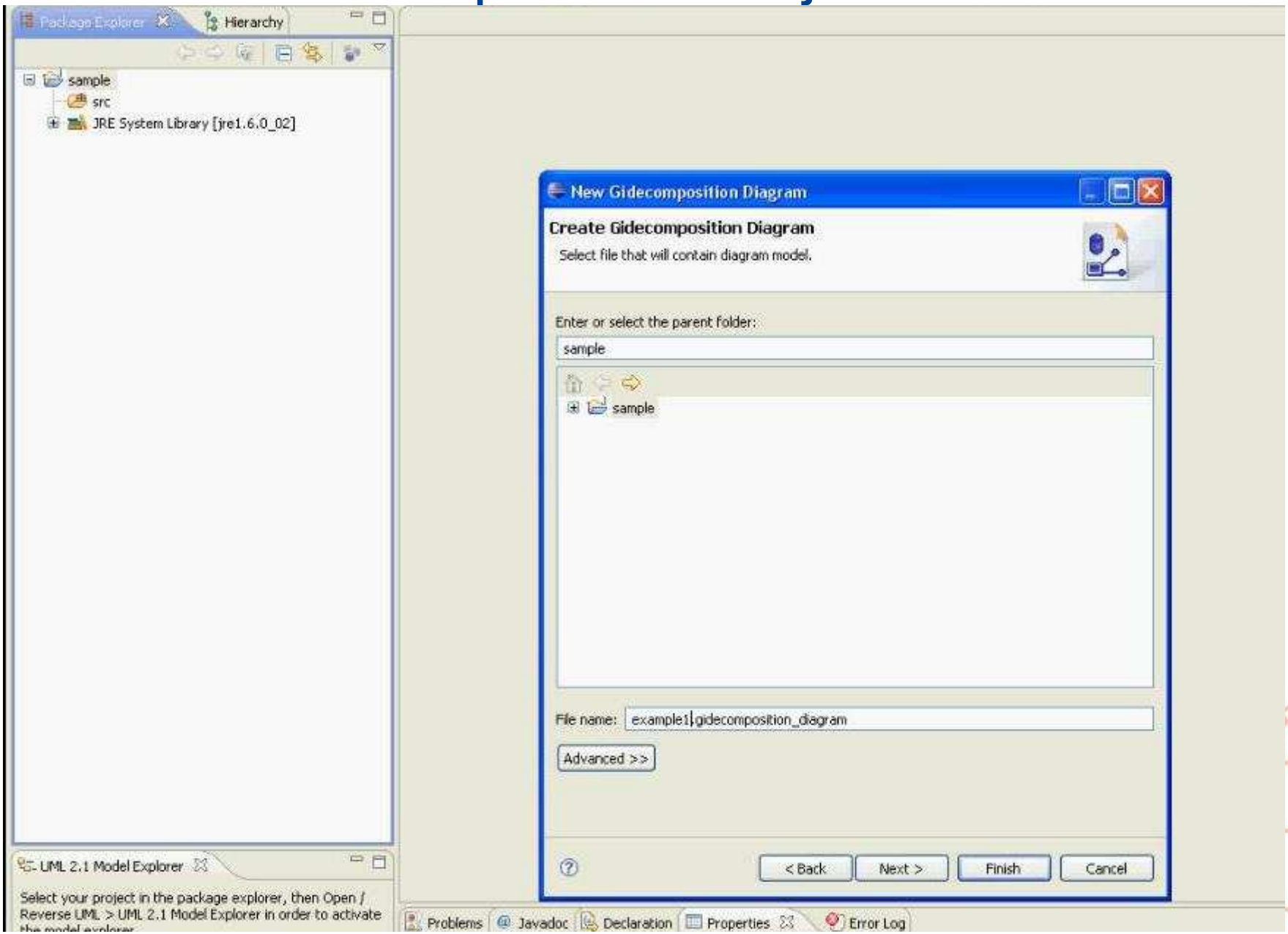



- Now create an “Other Project” – GIDE-Composition

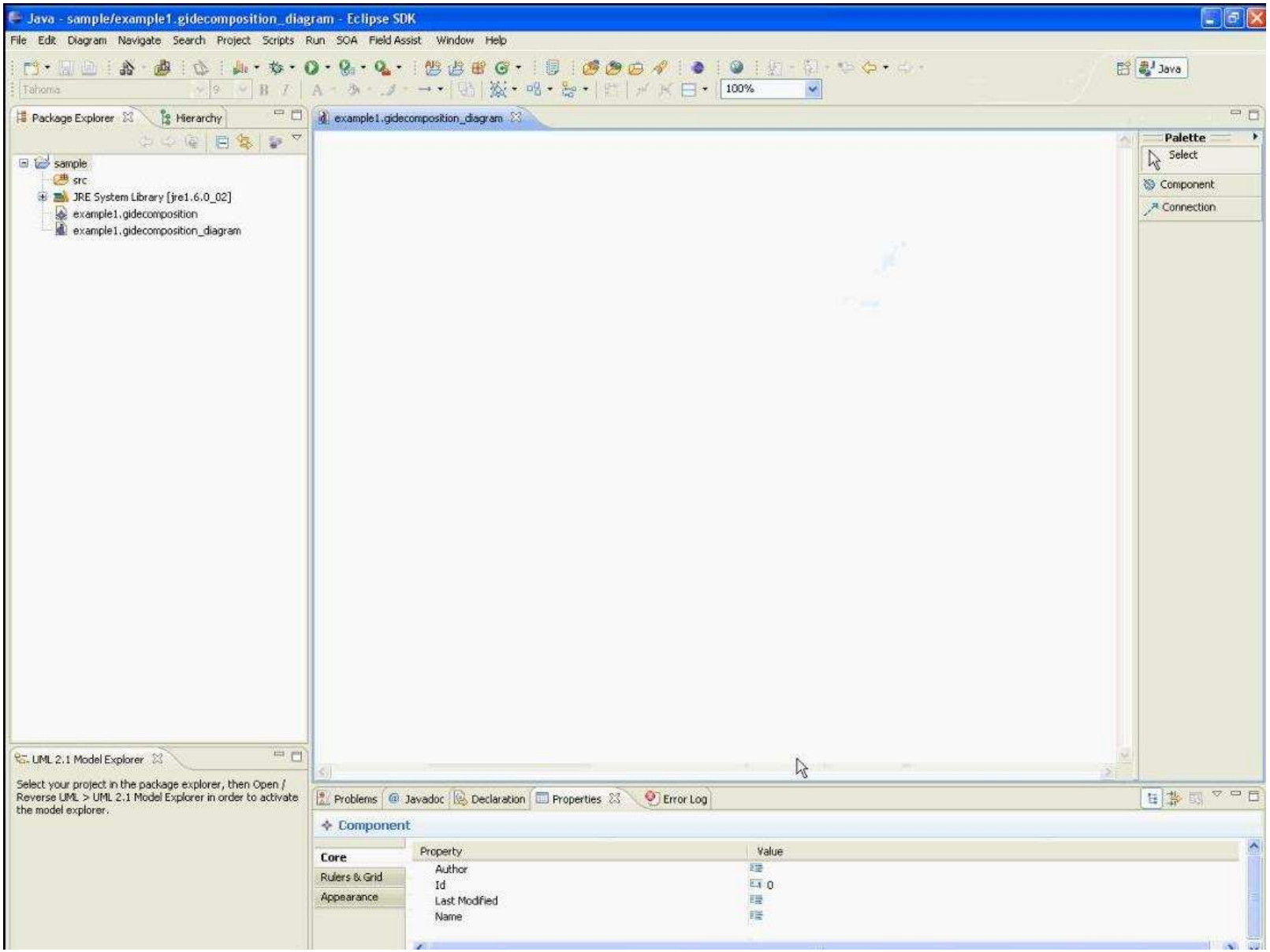



Java - Eclipse SDK
File Edit Source Refactor Navigate Search Project Scripts Run SOA Field Asset Window Help
Java
Package Explorer
Hierarchy
sample
src
JRE System Library [jre1.6.0_02]
New Gidecomposition Diagram
Create Gidecomposition Diagram
Select file that will contain diagram model.
Enter or select the parent folder:
sample
sample
File name: example1.gidecomposition_diagram
Advanced >>
< Back
Next >
Finish
Cancel
UML 2.1 Model Explorer
Select your project in the package explorer, then Open / Reverse UML > UML 2.1 Model Explorer in order to activate the model explorer.
Problems
Javadoc
Declaration
Properties
Error Log
Property
Value
Info
derived
false
editable
true
last modified
13 September 2007 14:46:17
linked
false
location
D:\Works\Research\Eclipse\WorkSpaces\runtime-EclipseApplication\sample
name
sample
path
/sample

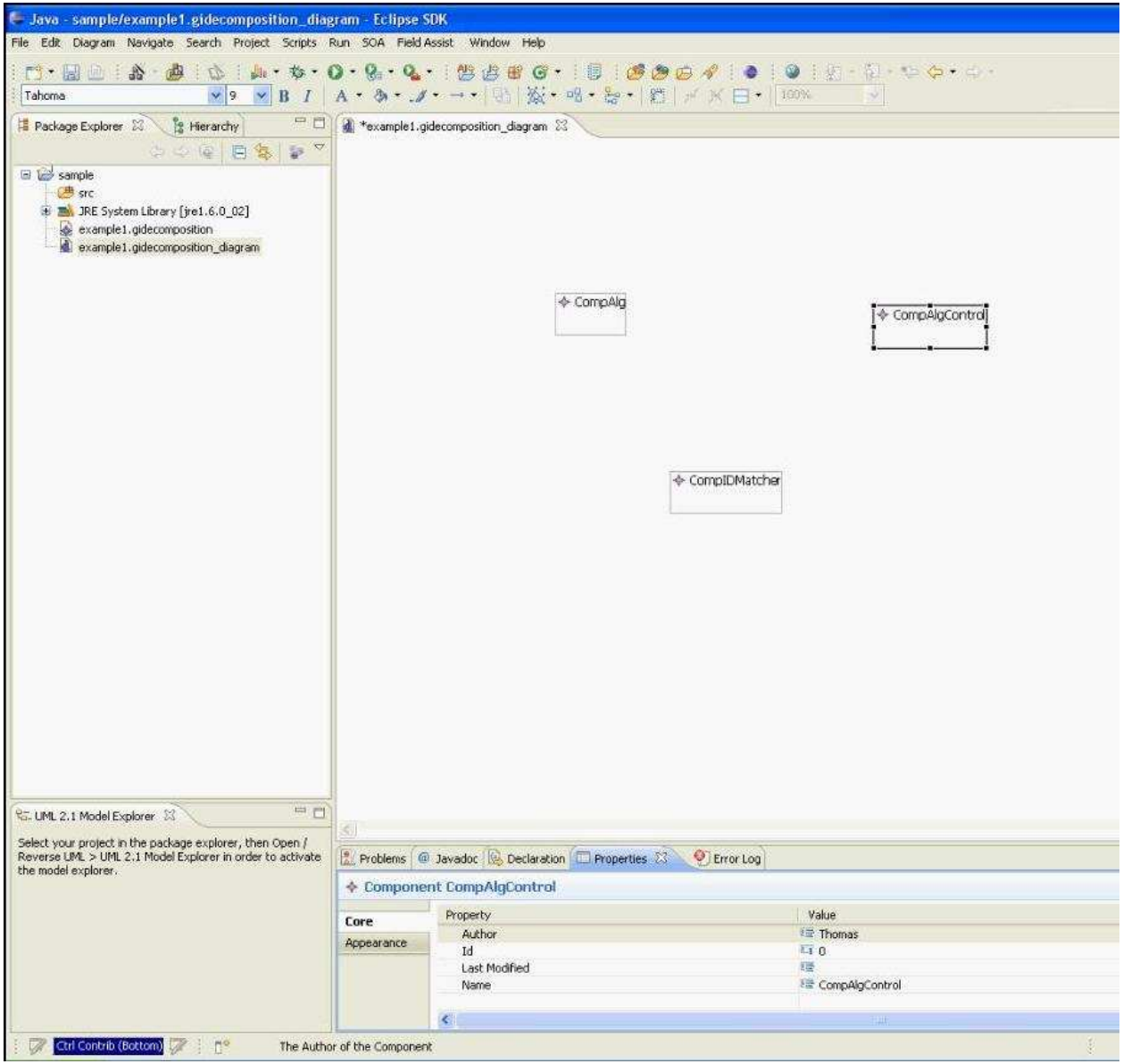
- Name the Composition Project



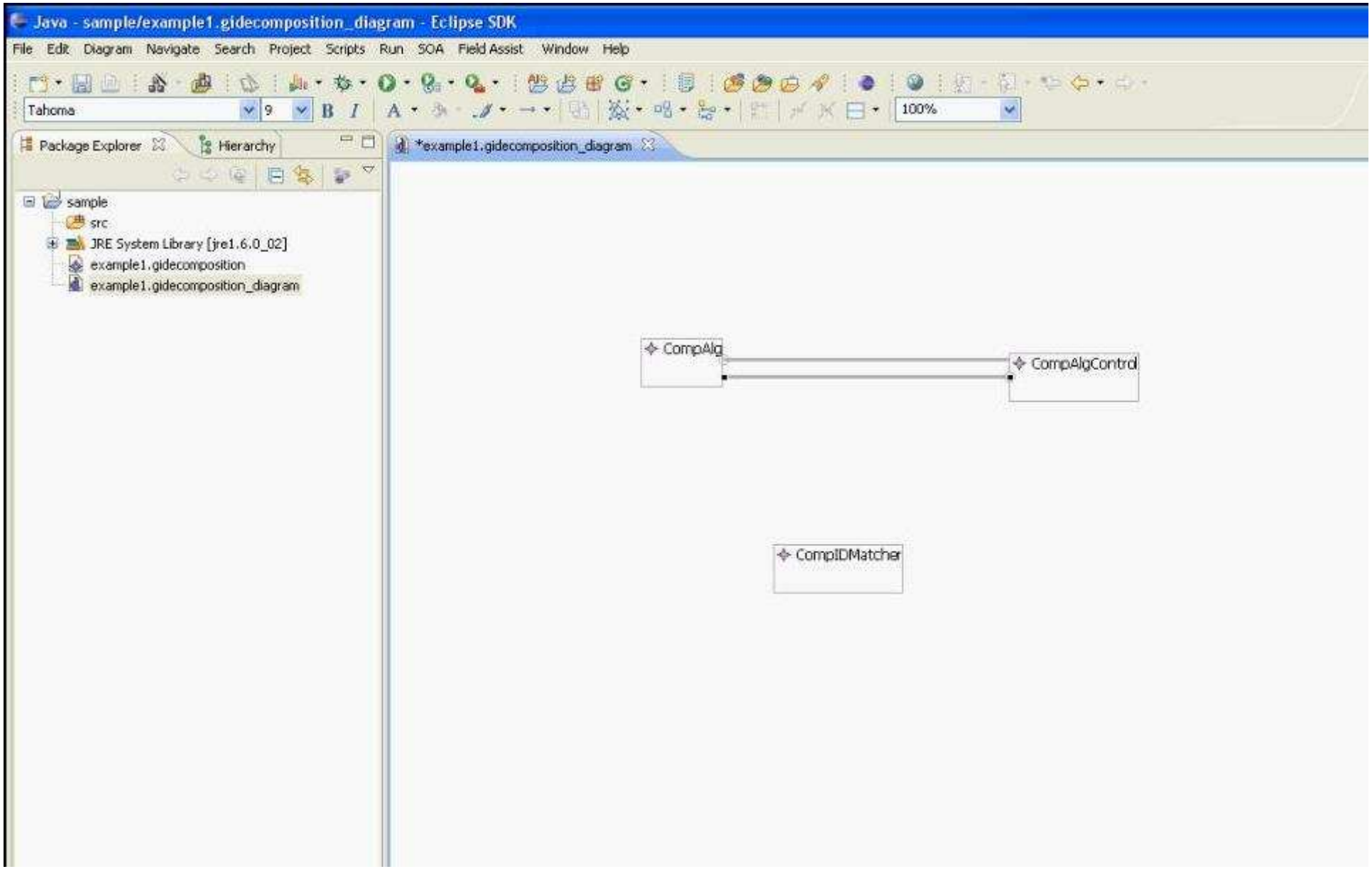
- This should create two files (semantic and diagram)
- Should bring the canvas for composition



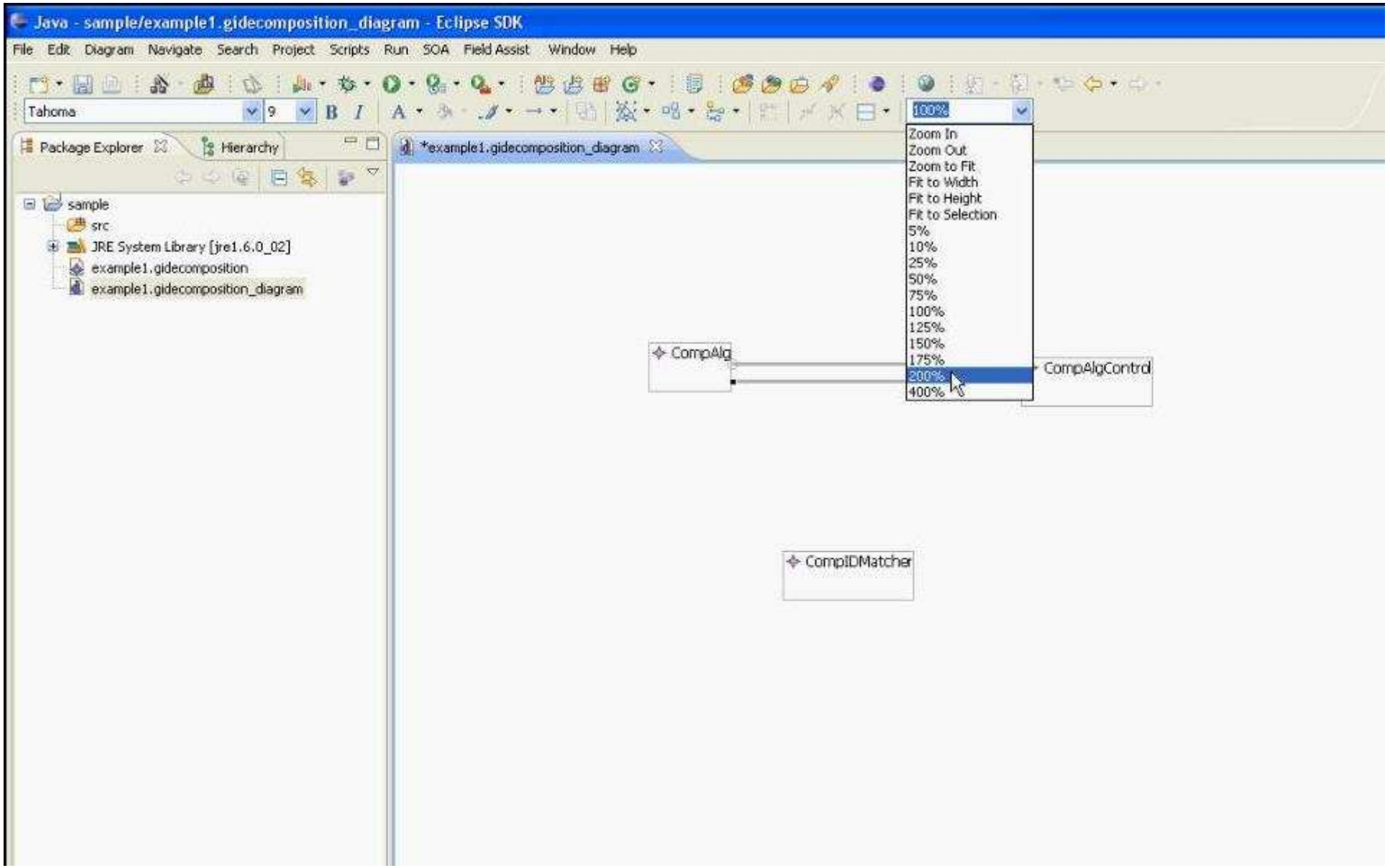
- Drag and drop component from toolbox
- Change properties



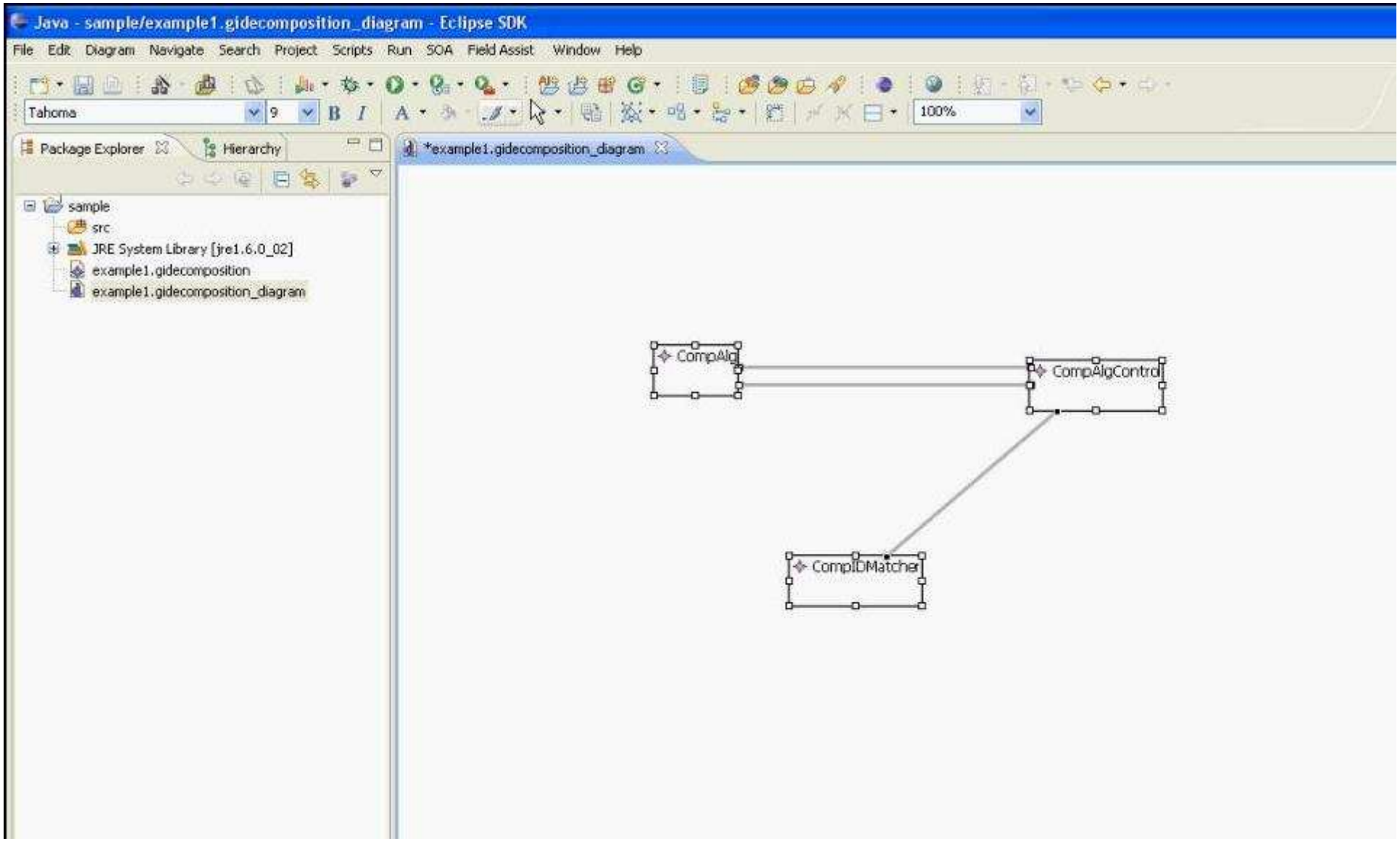
- Create a connection between them by using the link tool



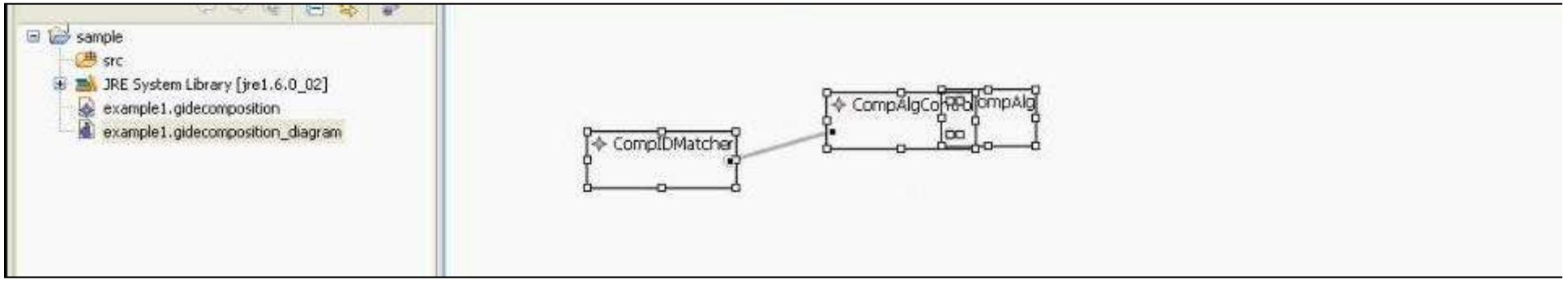
- Zoom in, if necessary

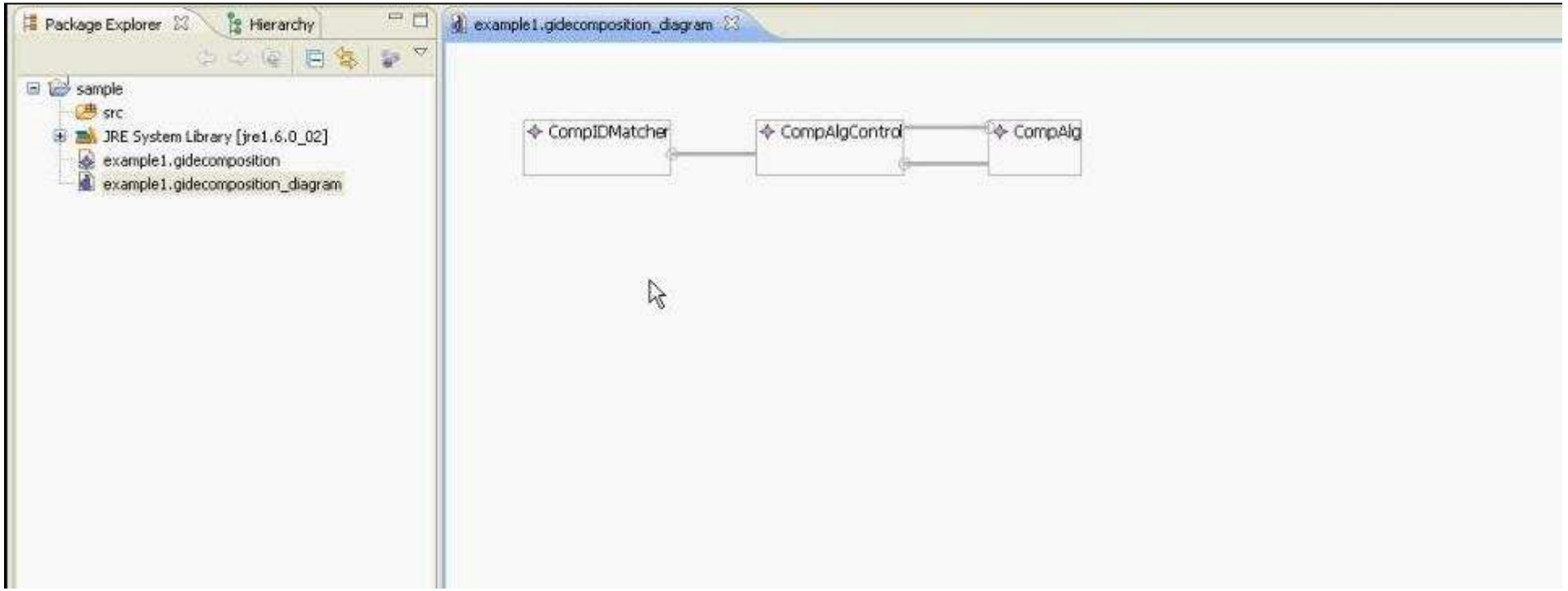


- Once created, select and arrange them for better layout

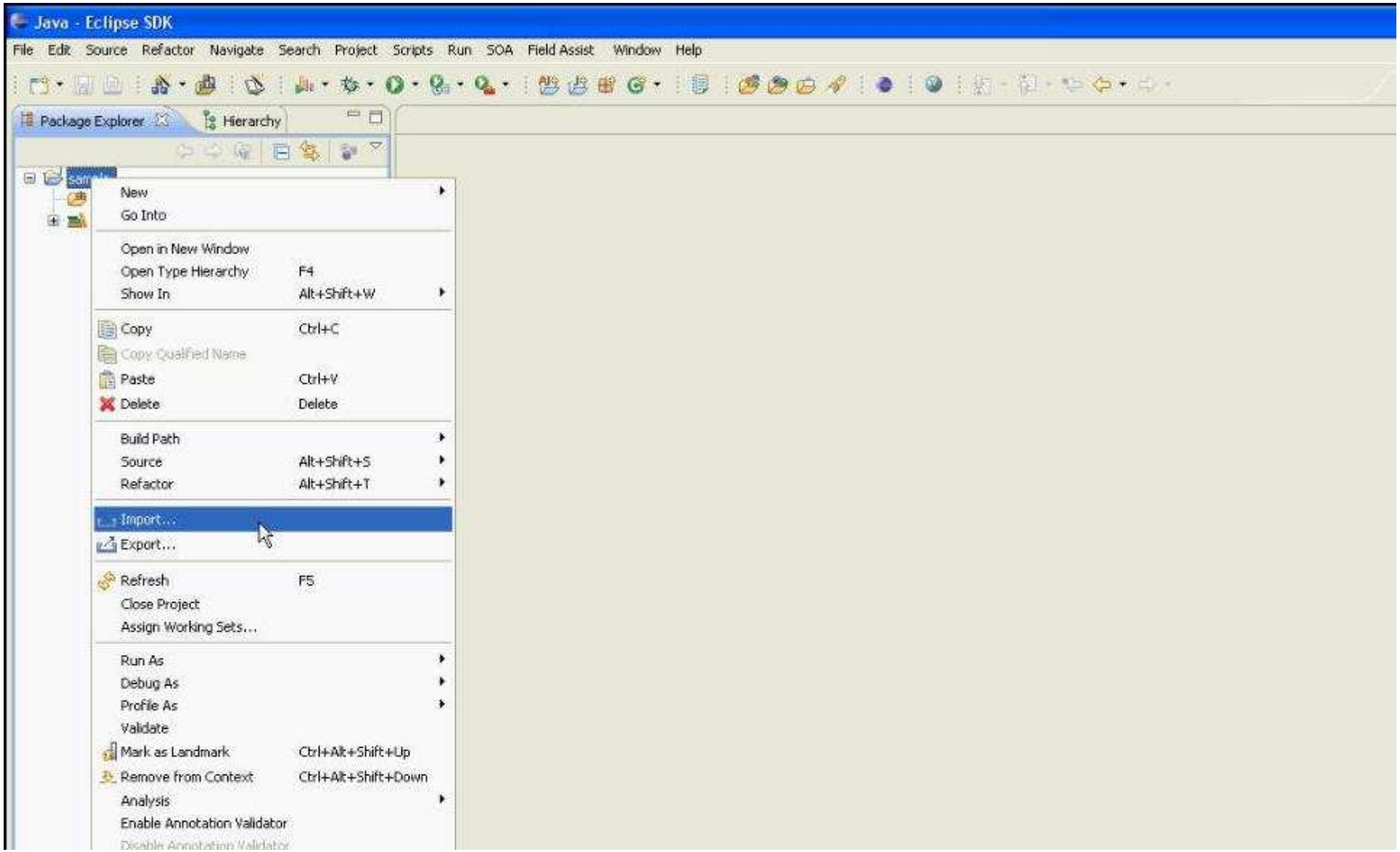


# *The auto-arrangement is done by GMF-backend*

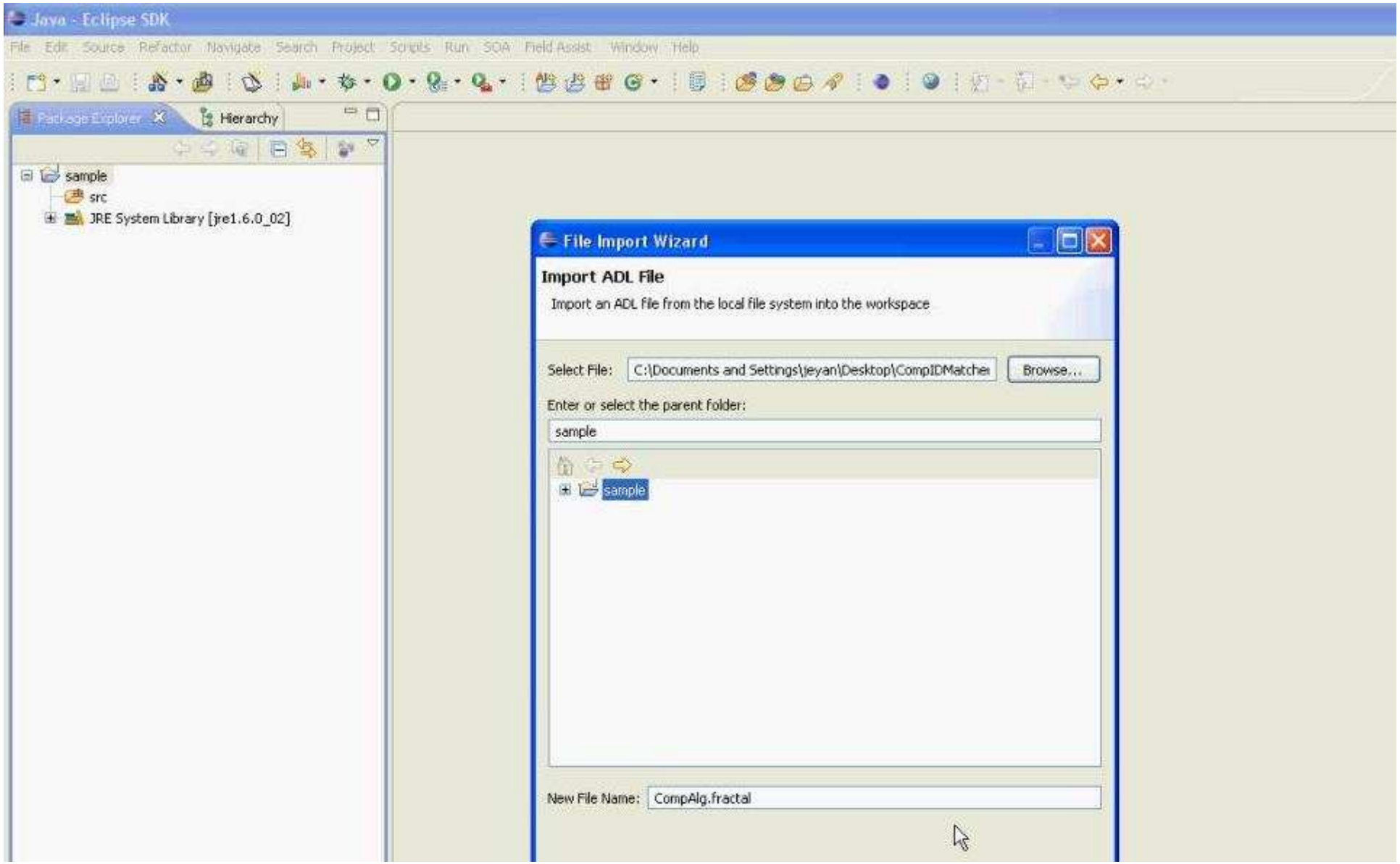


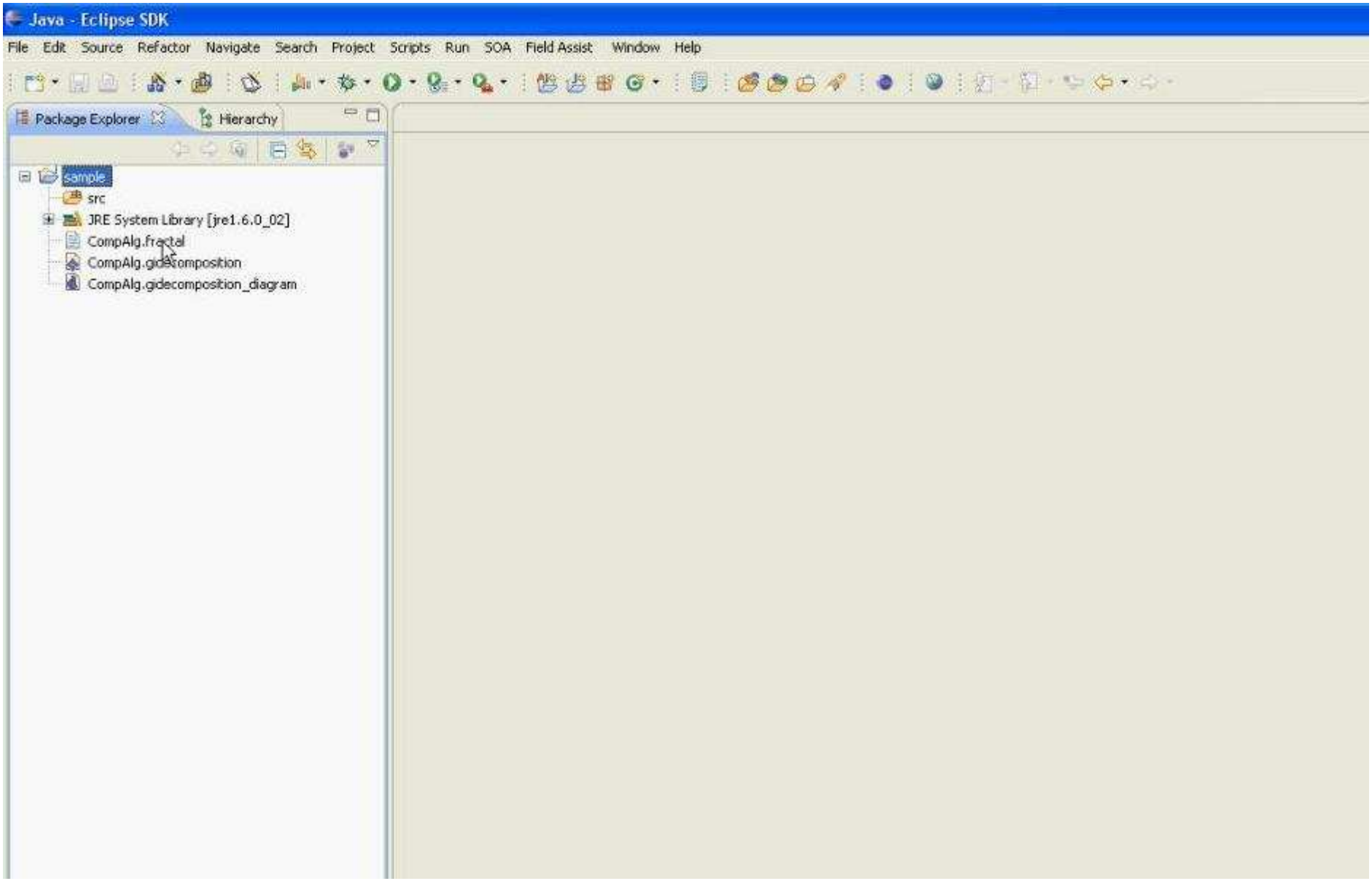
- To Import ADL Files, select Import from the file Menu and select the file for import.



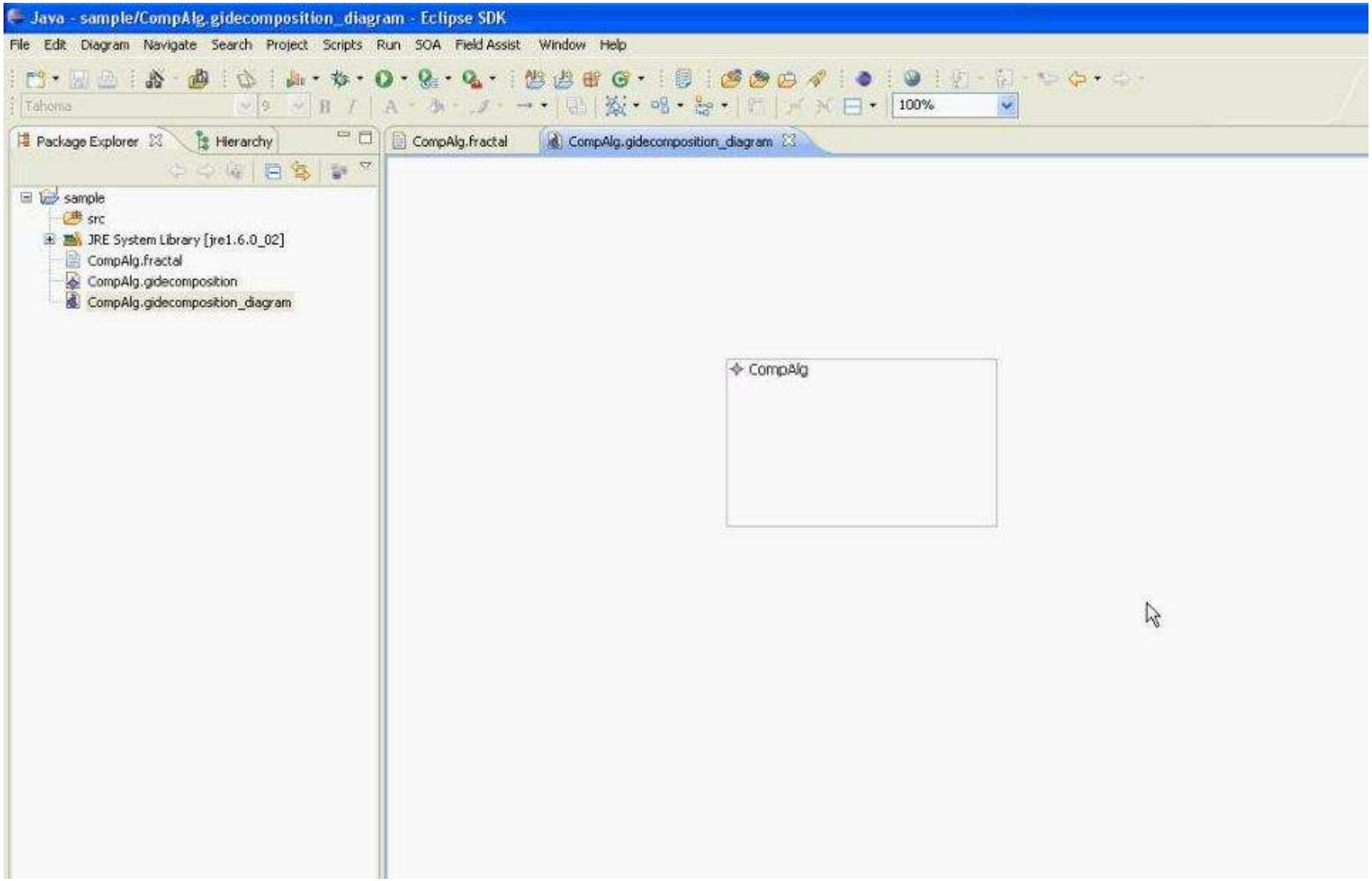
- Select the project space to import into



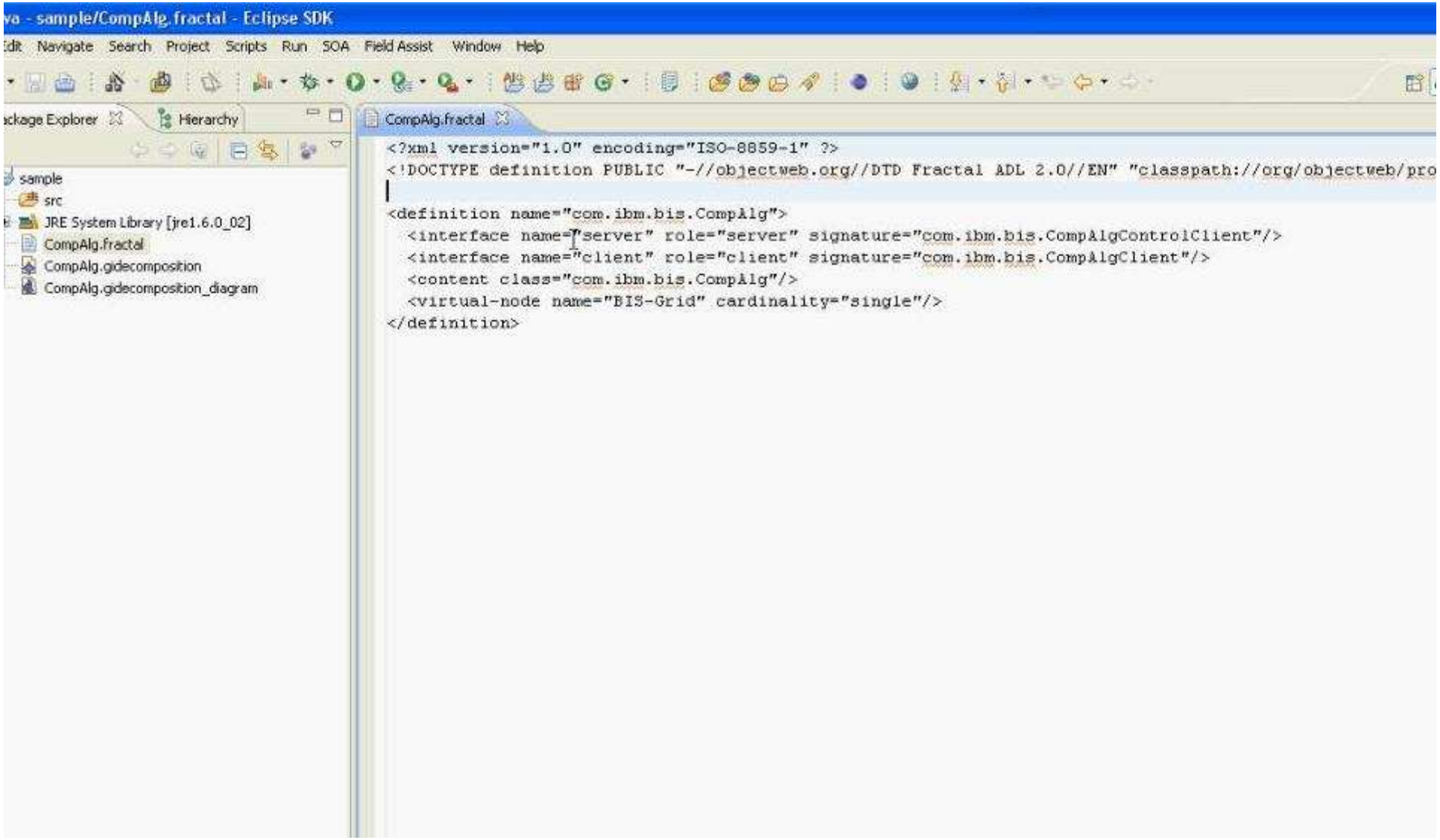
# *The file will be imported along with the semantic/diagram files*



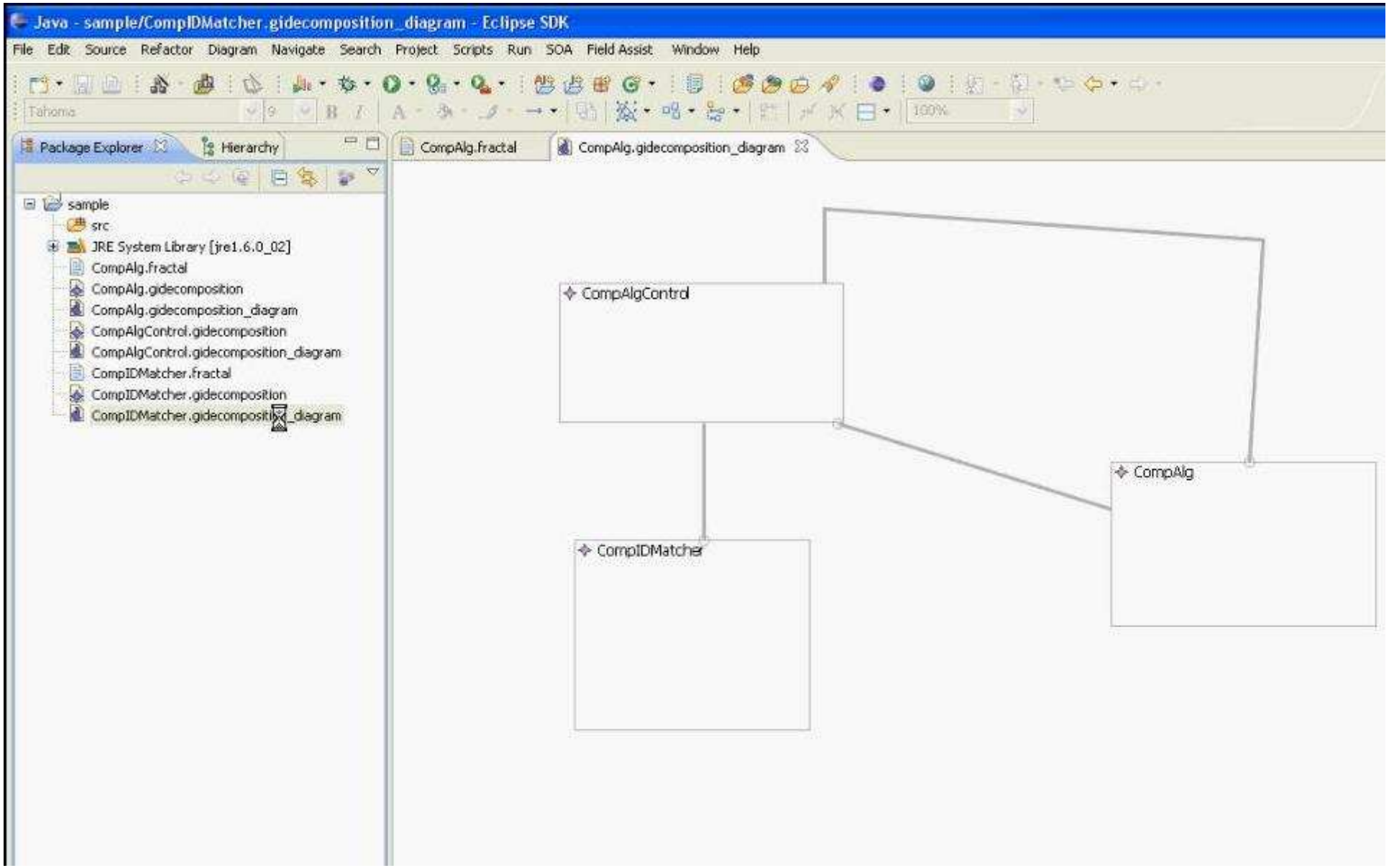
# Diagram will be rendered automatically



- The underlying ADL file can be edited

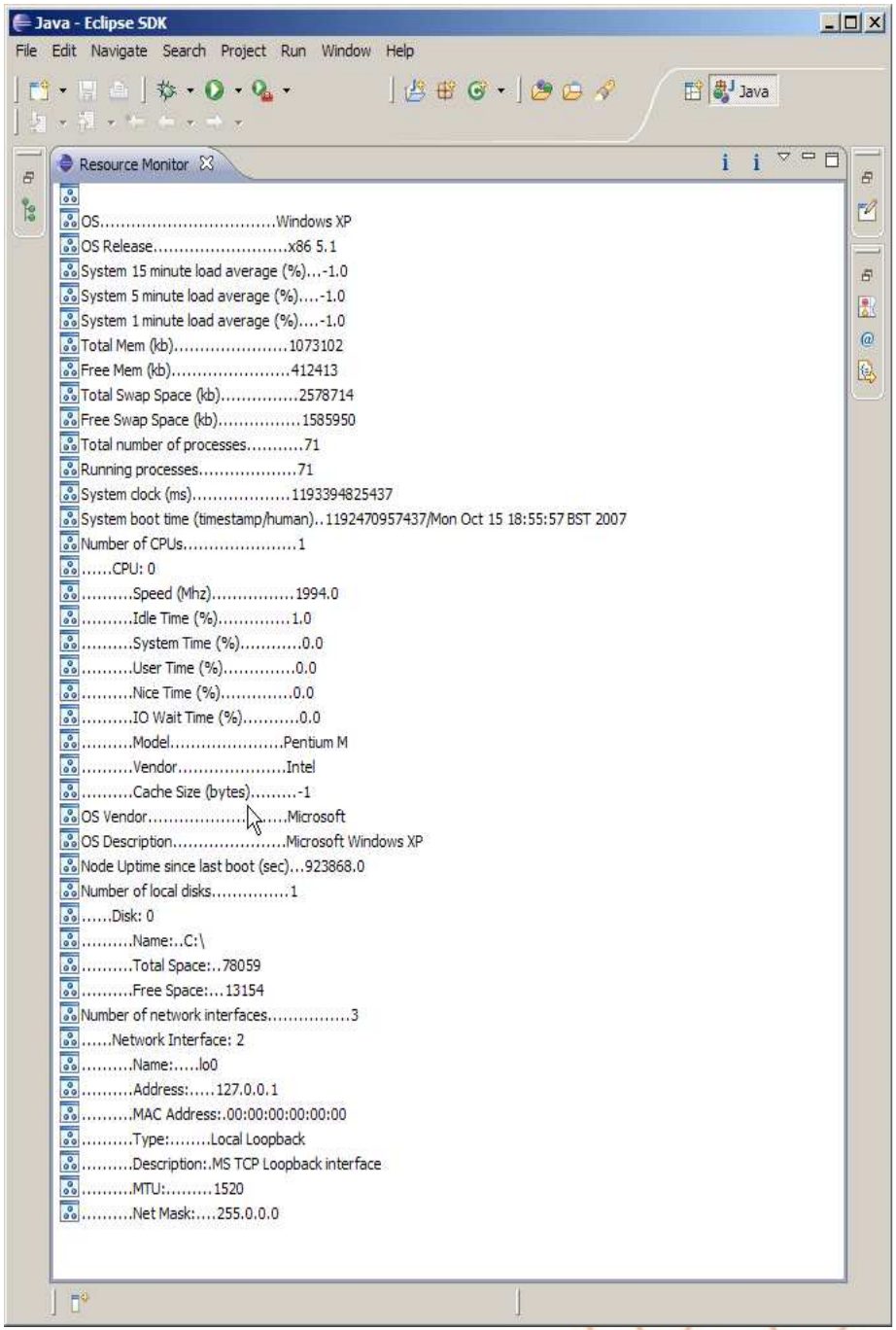


- Composite components can also be imported by selecting the composite ADL file



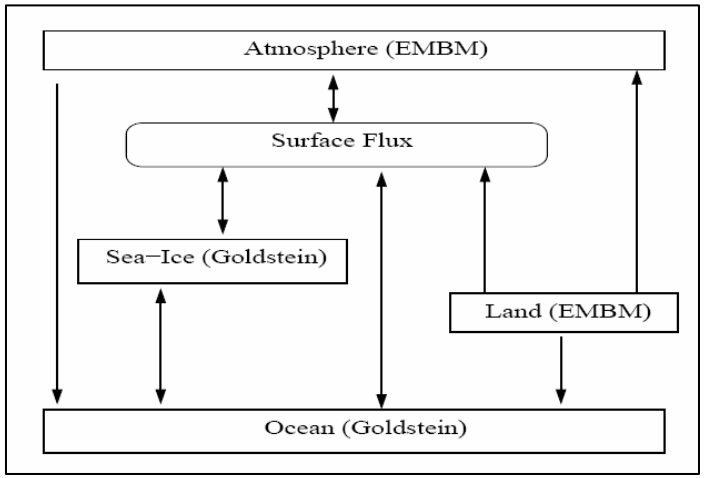
# Resource Monitoring

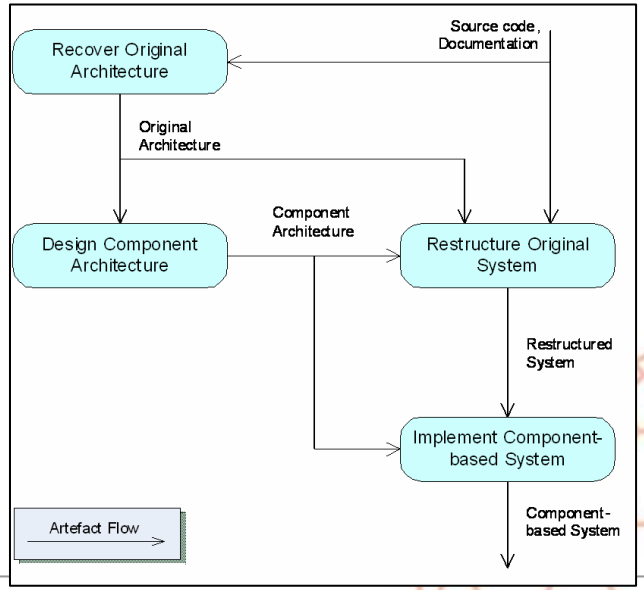
- Enables an operator to dynamically view the underlying resources prior to deployment
- Implemented using a highly scalable, high-performance and platform independent library
- Permits remote monitoring



# Approaches for componentising legacy code

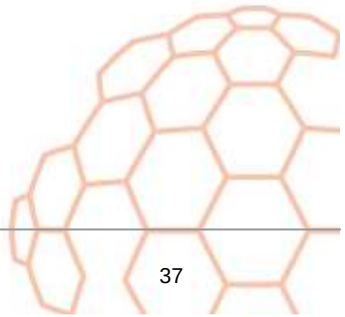
- The current version of GIDE has no direct support for legacy code-wrapping
- Support for such componentisation and code-wrapping is essential to support legacy applications
  - Current focus is on GENIE – Grid Enabled Integrated Earth System Modelling : componentised and Grid Enabled
  - Alternative approach is to hand-tune the code to comply with the underlying model – JEM3D
- Future version of the GIDE may support GCM-compliant code wrapping



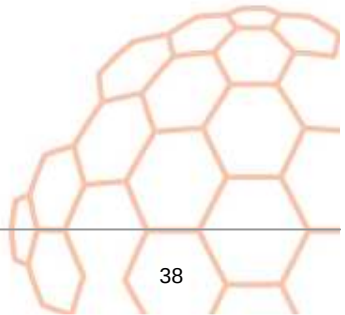
# Some Future Goals

- Utilise the Eclipse GMF approach for providing highly interactive development IDE
- Support and different interface types
- Improved support for ADL files
- Implement and Integrate component monitoring
- Optional: model verification, improved context support for managing ADL files



# Conclusions

- Implemented an initial version of the prototype of GIDE to support GCM
- Adopted GMF approach and re-engineered the overall design
- Integrated platform supports better resource monitoring
- Further work is needed to align with production usage



# END

- Questions