Automatic Layout and Structure-Based Editing of UML Diagrams

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Outline

Pragmatics of MBE

- Semantics define the structure and meaning of a model
  - how to *interpret* it

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- Syntax defines the notation of a model
  - how to *visualize* it
- Pragmatics defines the interaction with a model
  - how to *edit* it

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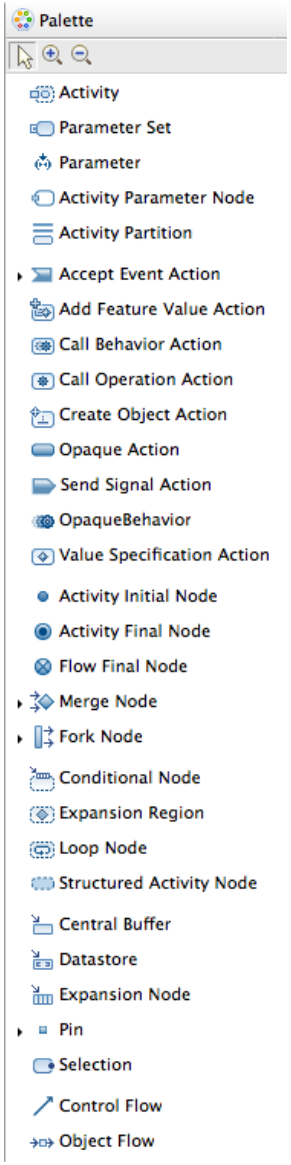
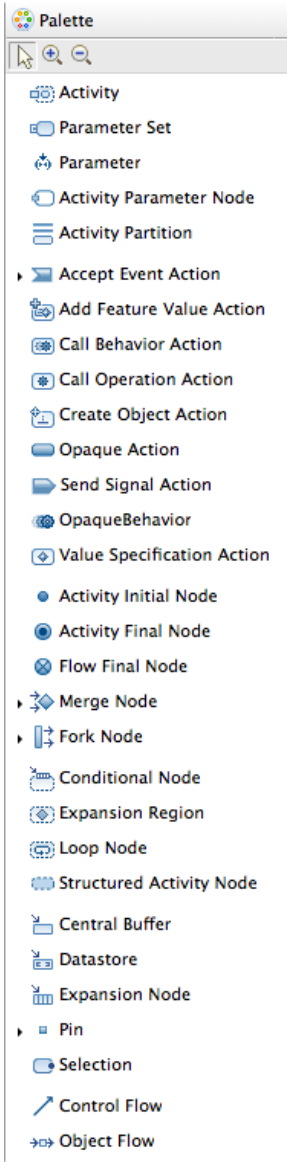


Pragmatics of MBE

- Textual editing is well known
- Advanced editors offer versatile assistance for editing and formatting of text
  - 1-dimensional representation: relatively simple problem
- Graphical editing often limited to *drag-and-drop*
- Little automated editing and formatting
  - 2-dimensional representation: complex problem



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Perform structural modification, then let the computer do the layout!

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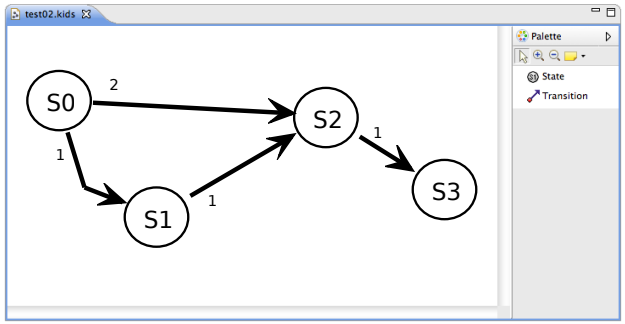
Eclipse Integration



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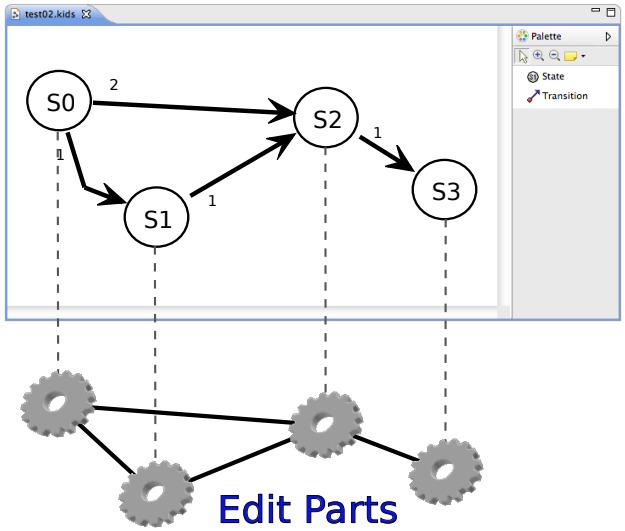

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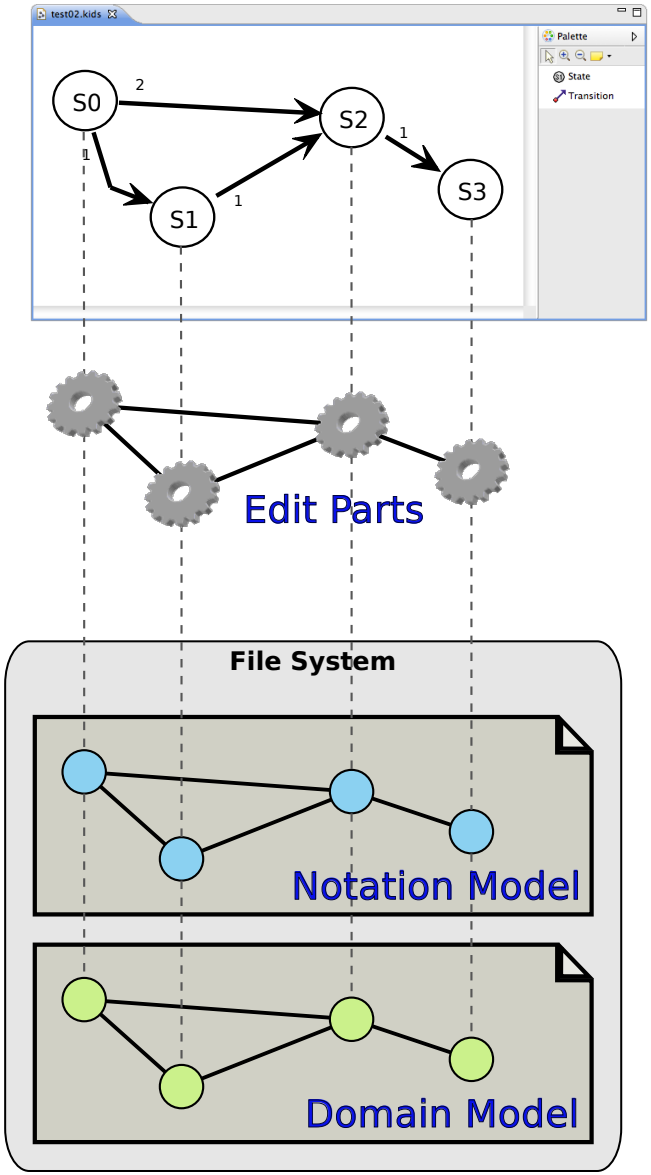

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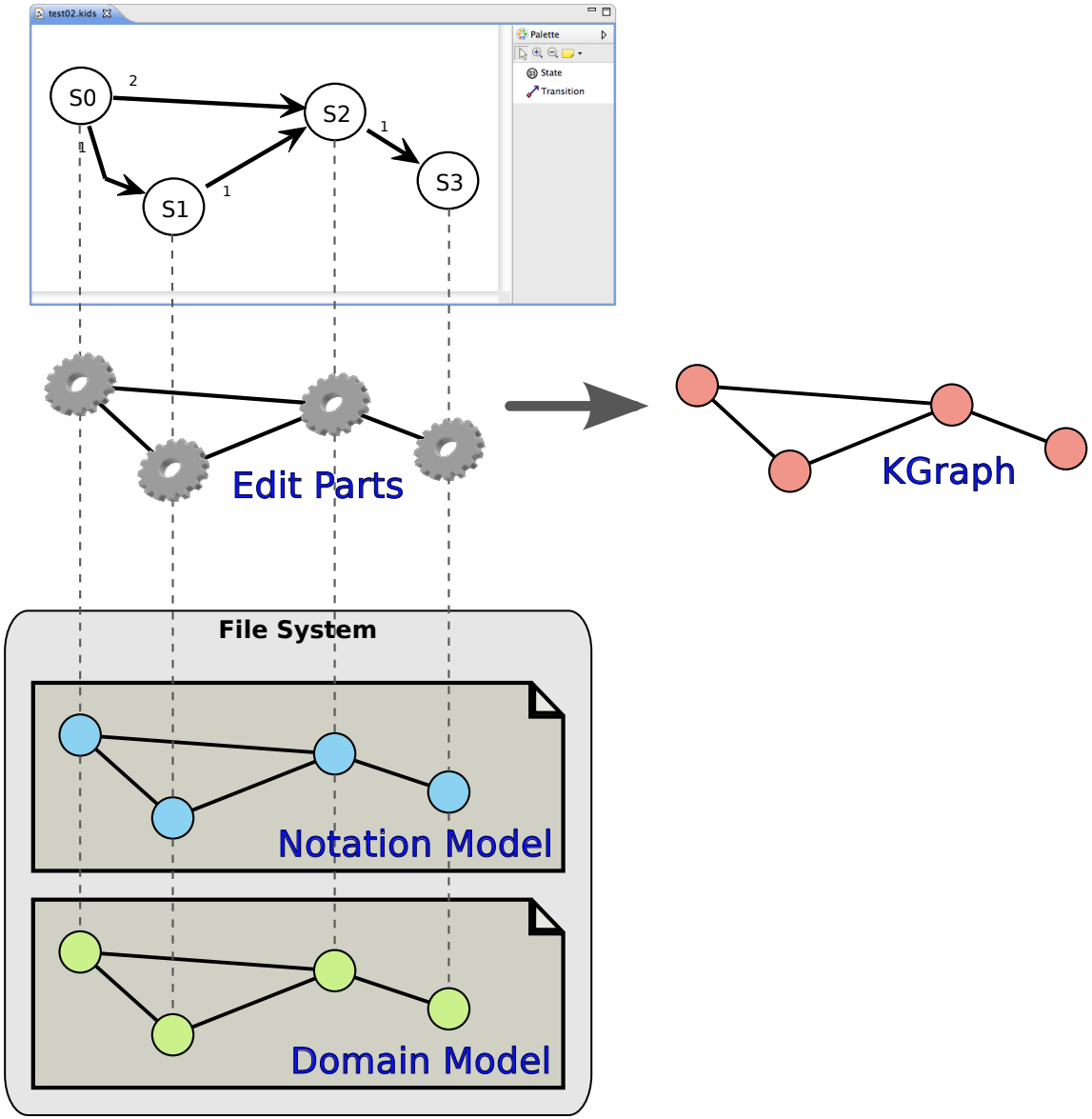

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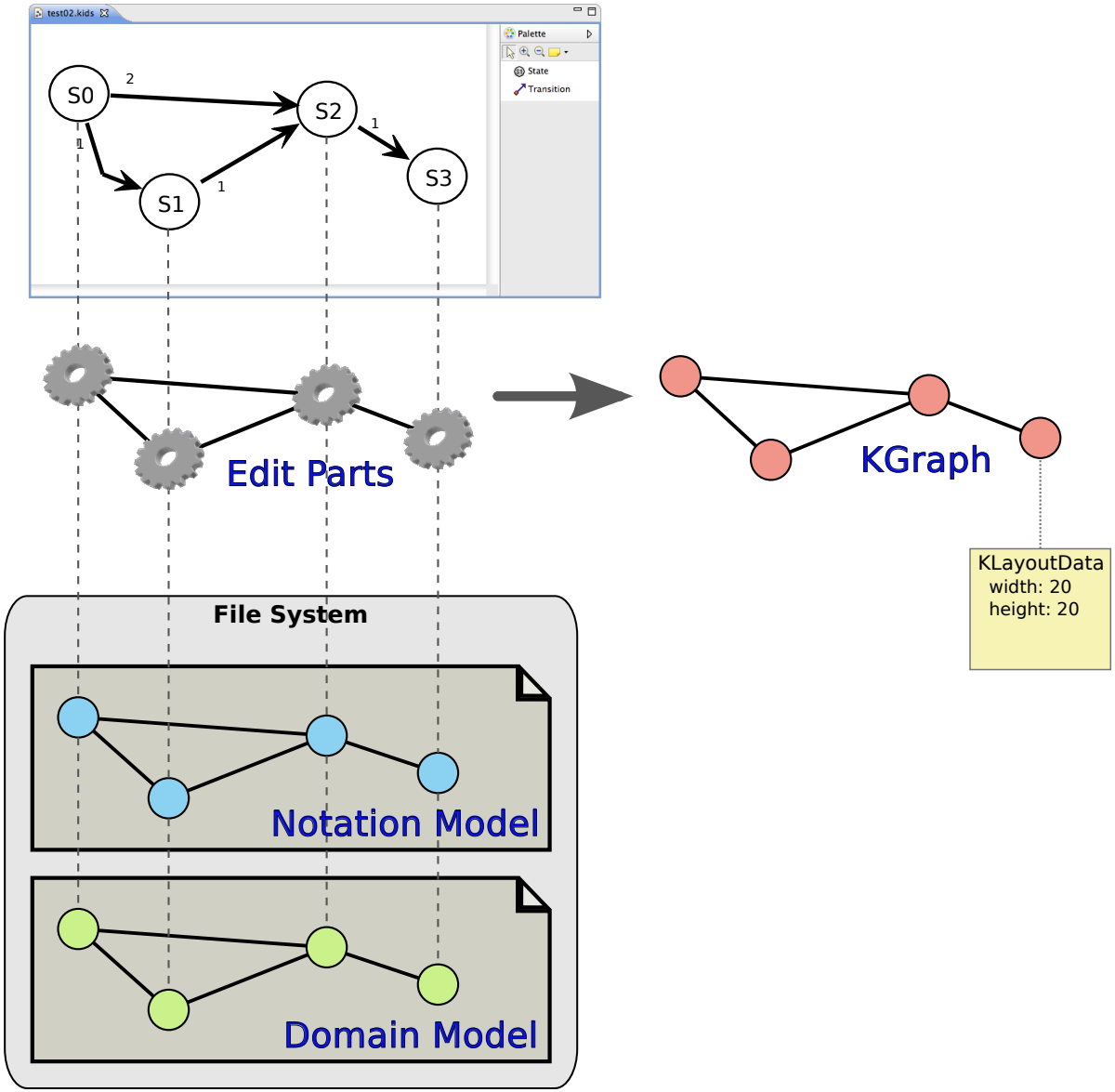

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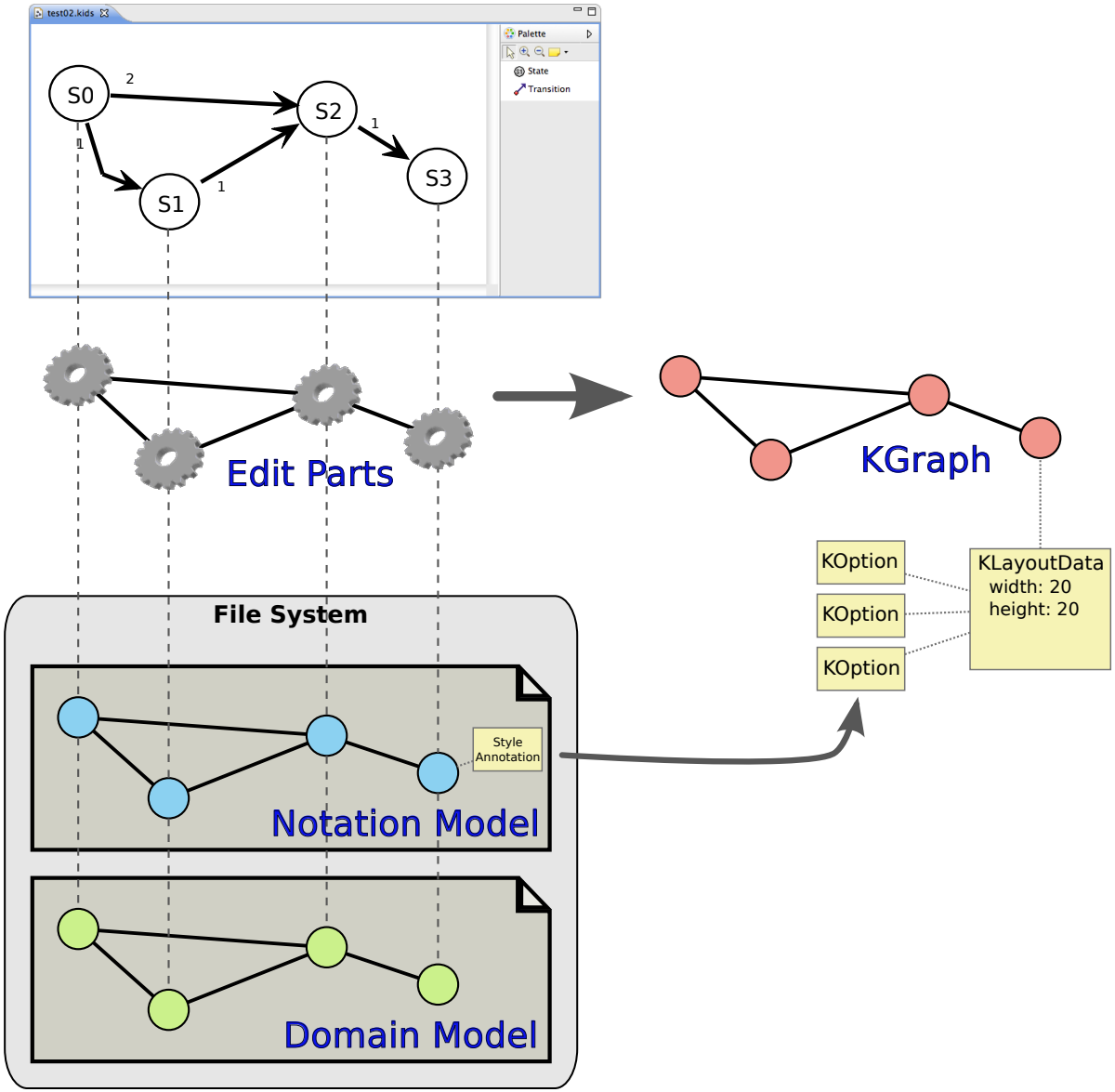

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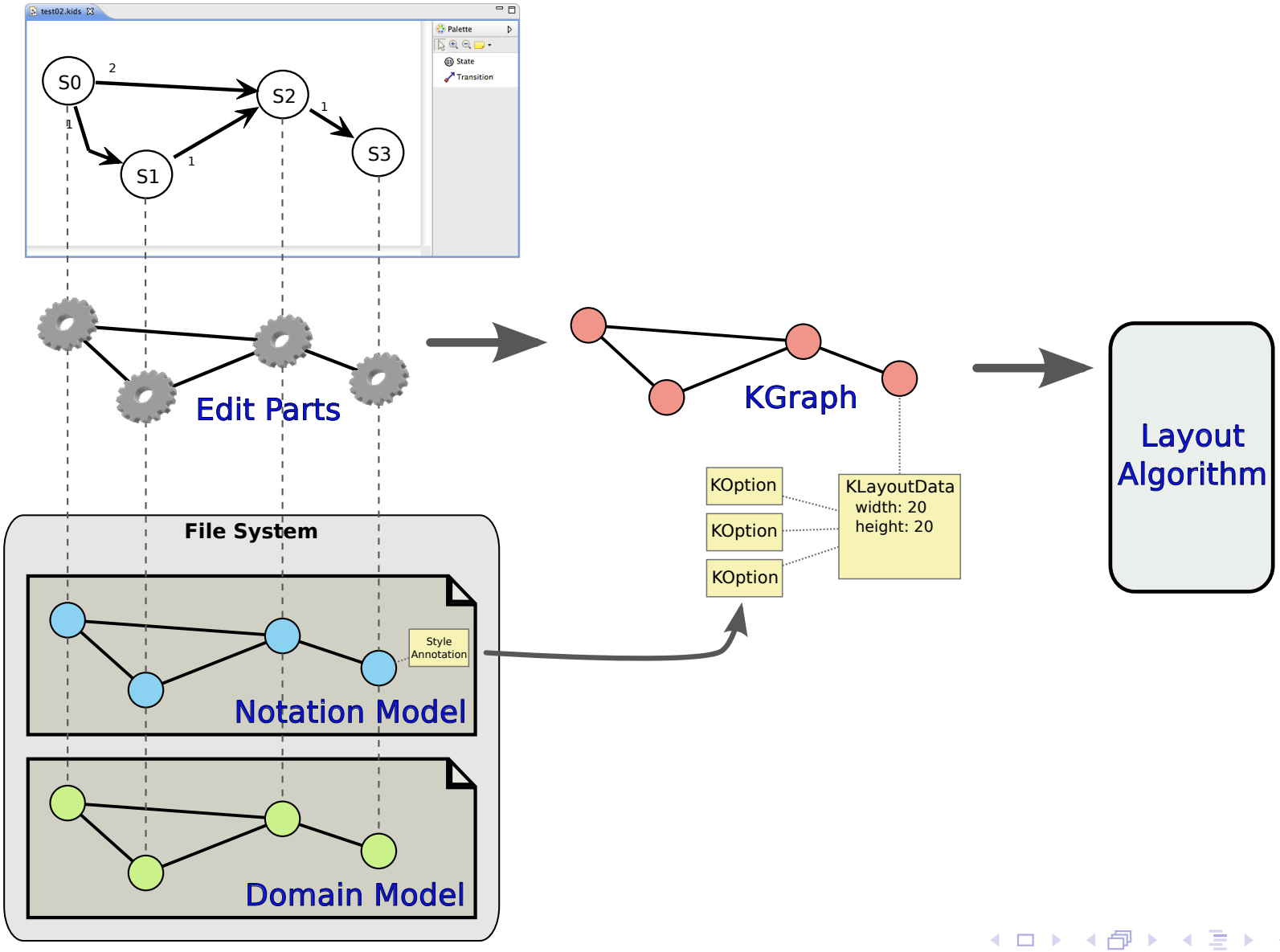

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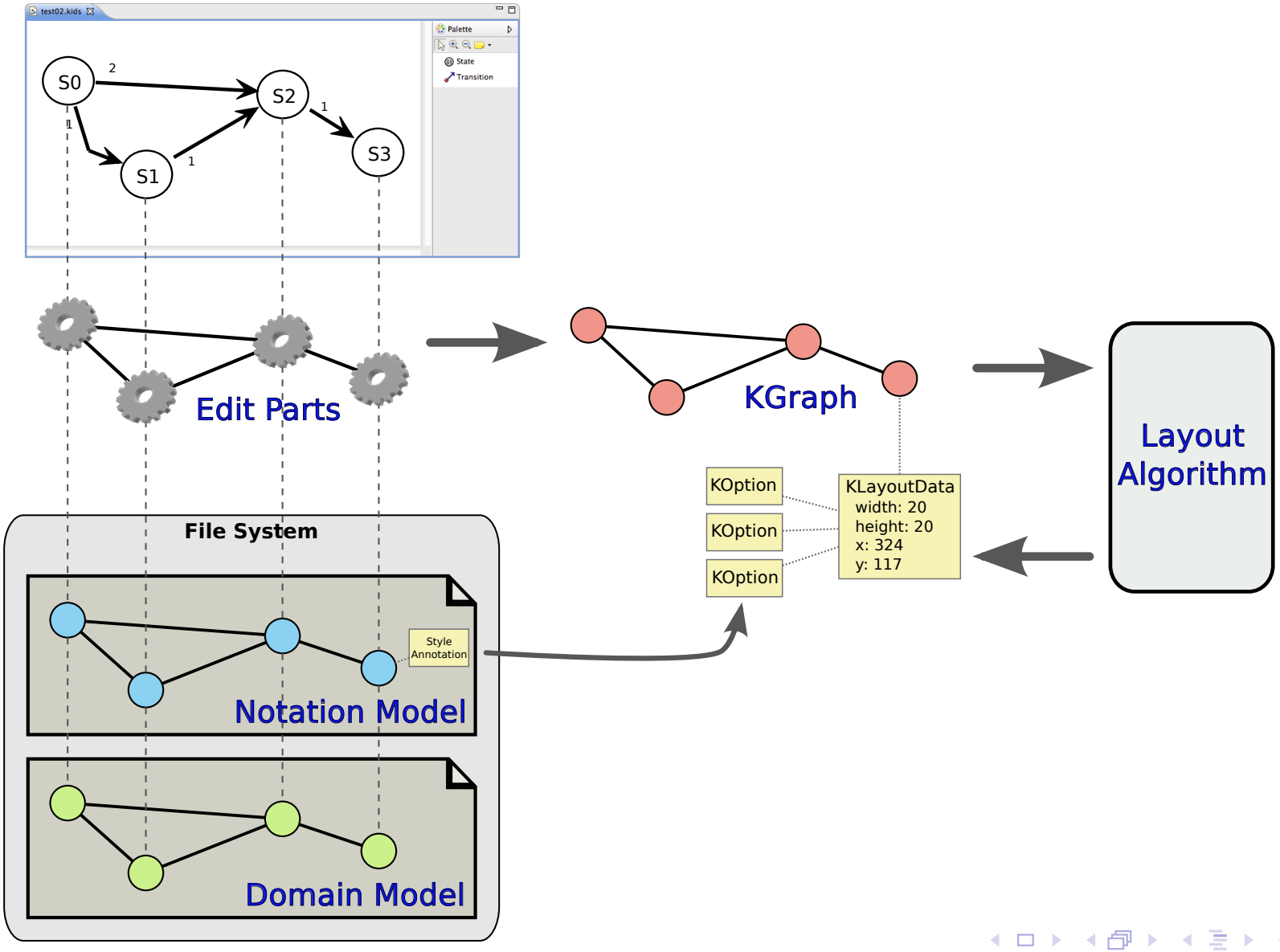

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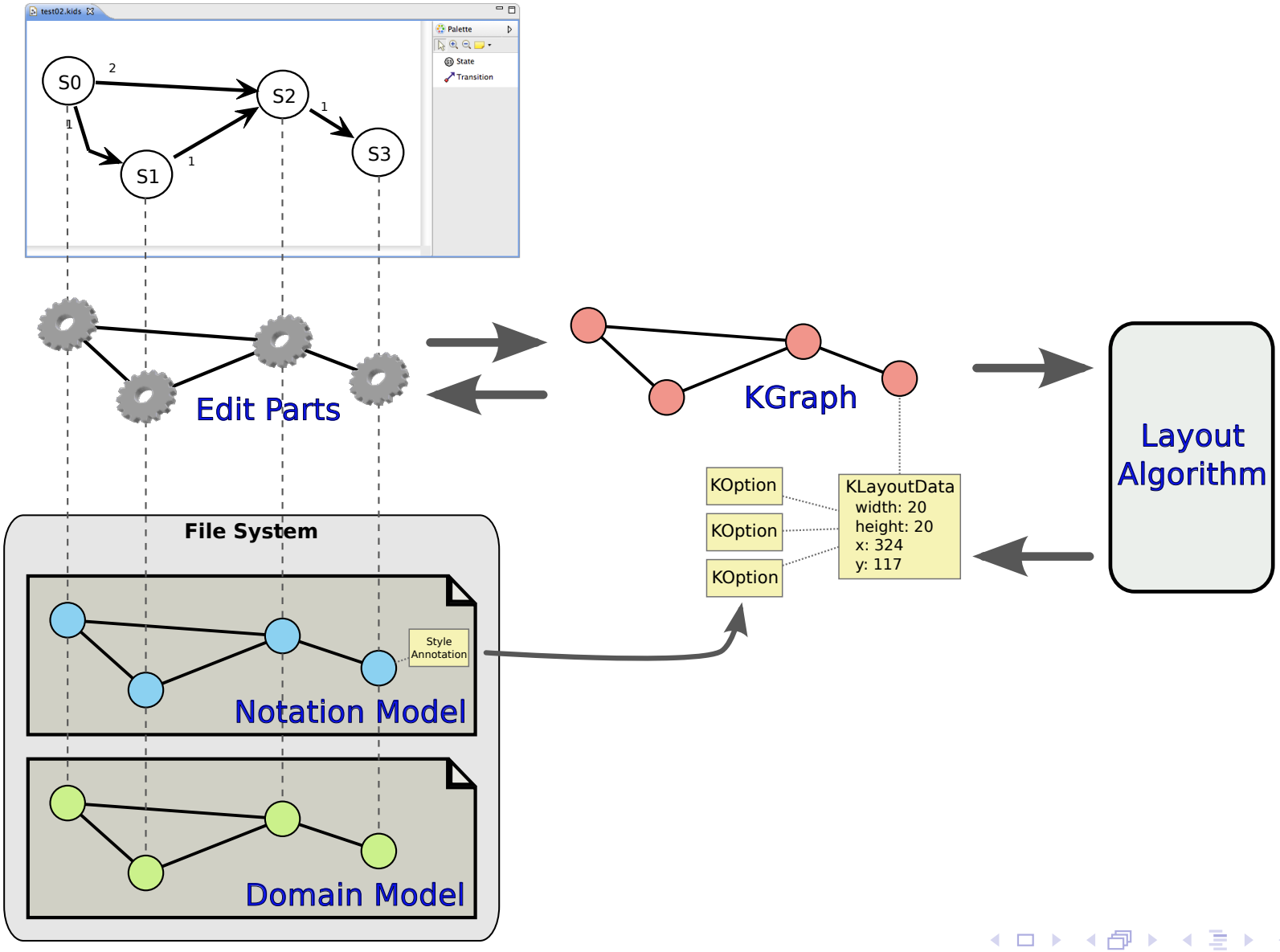

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Layout works without any adaptions for most editors of the Eclipse Graphical Modeling Framework (GMF).

Graph Drawing Algorithms

- Connect existing implementations to our layout interface:
  - Graphviz, a widely used command line tool
  - Zest, part of the Eclipse Graphical Editing Framework (GEF)
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Graph Drawing Algorithms

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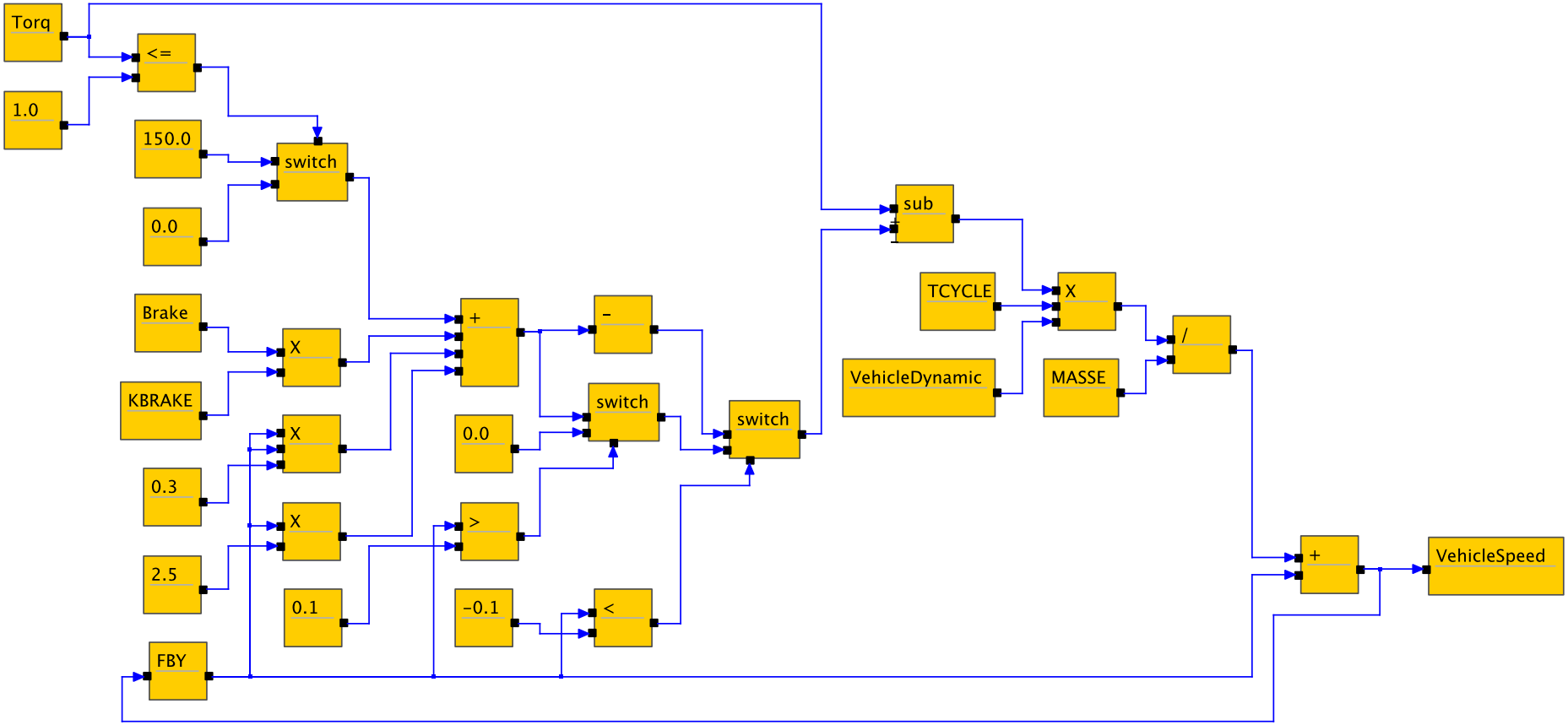
  - Graphviz, a widely used command line tool
  - Zest, part of the Eclipse Graphical Editing Framework (GEF)
  - OGDF, a C++ library developed at the TU Dortmund
- Specialized algorithms for specific diagram types
  - Developed a layouter for data flow diagrams, e. g. Simulink, SCADE, Ptolemy
  - OGDF has a special layouter for class diagrams

Data Flow Diagram Layout



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  - E. g. Xtend (Eclipse M2T project)

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  - E. g. Xtend (Eclipse M2T project)
- Operate directly on the semantic model instead of the notation model
- Perform automatic layout after each operation

Xtend Operations

- Create a successor action in an activity diagram

```
Void createSuccessor(Action action):
    let newAction = new OpaqueAction:
    newAction.setActivity(action.activity) ->
    controlFlow(action, newAction);

Void controlFlow(Action action1, Action action2):
    let flow = new ControlFlow:
    flow.setActivity(action1.activity) ->
    flow.setSource(action1) ->
    flow.setTarget(action2);
```

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- The UML metamodel has many specializations
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- Structure-based editing can be used to simplify this
- Write toggling operations that perform all these steps automatically

Conclusion

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- Concepts can be applied with minimal effort to all GMF diagram editors
  - E. g. SyncCharts, a synchronous Statecharts dialect

Conclusion

- Introduced a framework for automatic layout in Eclipse
- Perform structural operations employing automatic layout
  - Structure-based editing
- Concepts can be applied with minimal effort to all GMF diagram editors
  - E. g. SyncCharts, a synchronous Statecharts dialect
- Available in the open source project KIELER

Future Work

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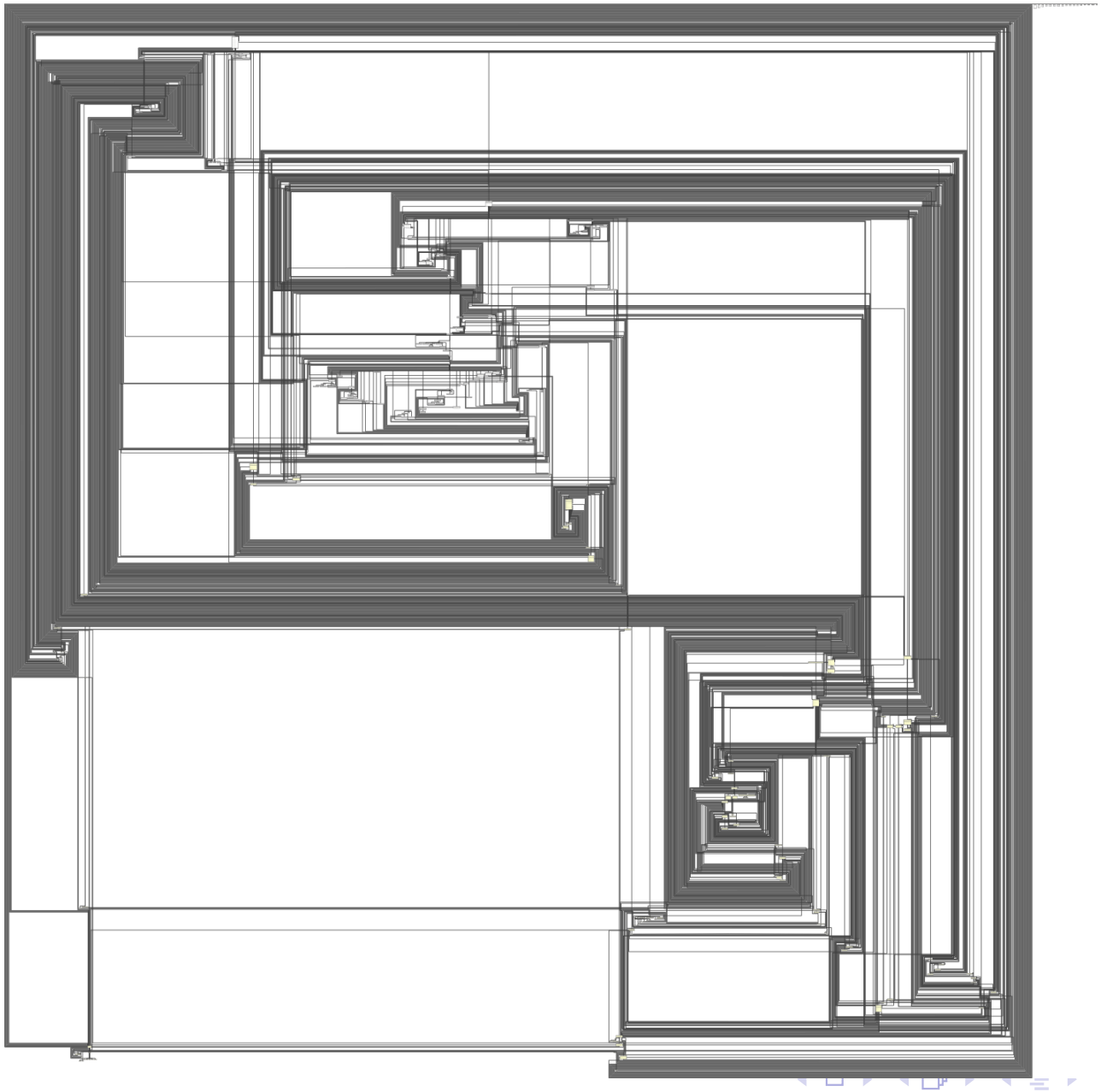
- Evaluate resulting operations in the context of actual development projects
- Synchronize graphical diagrams with textual representations
- View management: dynamic creation of graphical views
  - Display models with different levels of detail

View Management: UML Metamodel



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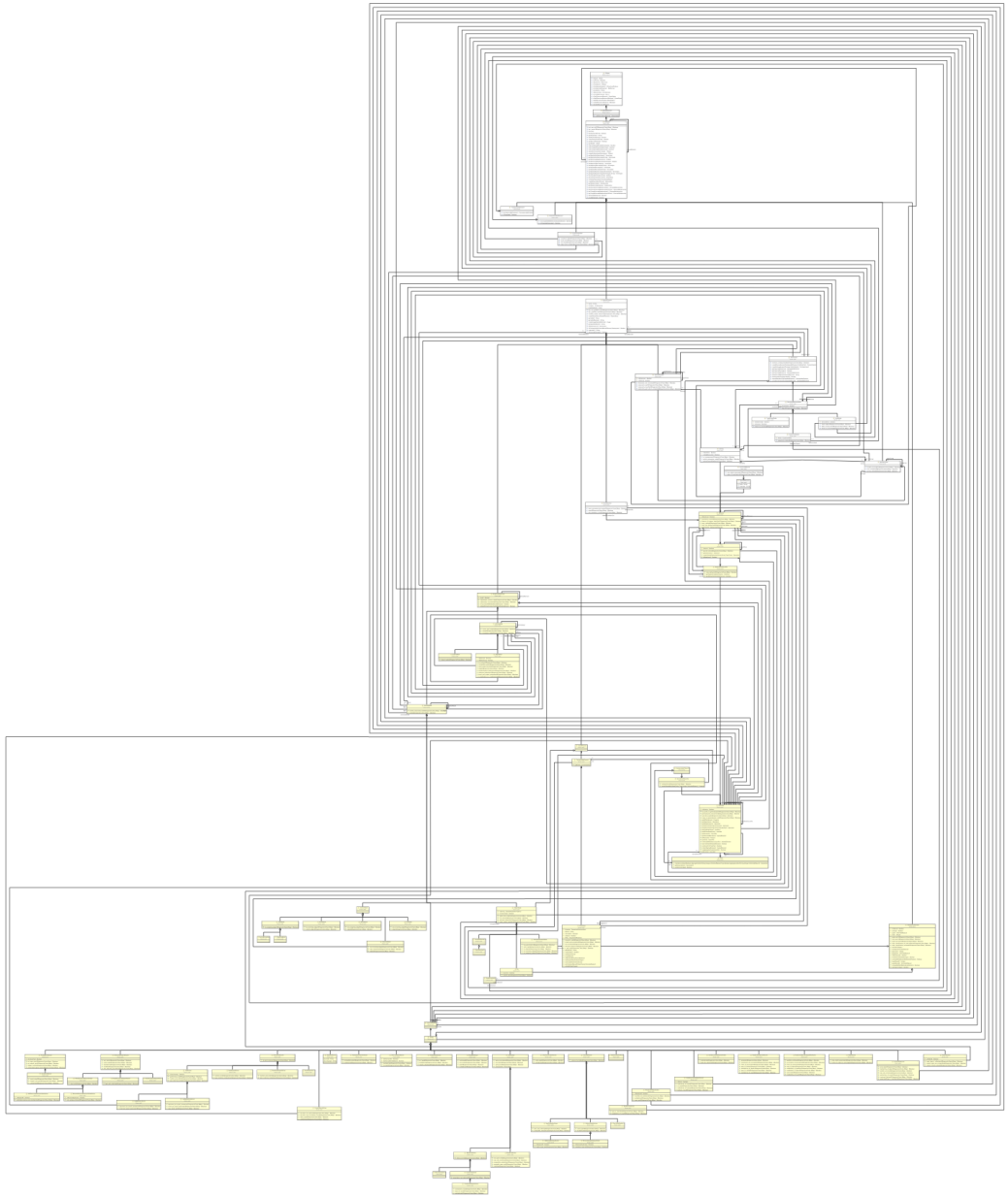

Contact

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