Taming Graphical Modeling
On Pragmatics-Aware Model-Driven Engineering

KIELER
Kiel Integrated Environment for Layout Eclipse RichClient

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MDE Workshop
HPI, Potsdam, May 30, 2014

Pragmatics of Model-Based Design

Pragmatics: relation of signs to their users

Pragmatics of Model-Based Design

Pragmatics: relation of signs to their users

$+$

Syntax: relations between signs

Pragmatics of Model-Based Design

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Semantics: relations between signs and the things they refer to

Pragmatics of Model-Based Design

Pragmatics: relation of signs to their users

$+$

Syntax: relations between signs

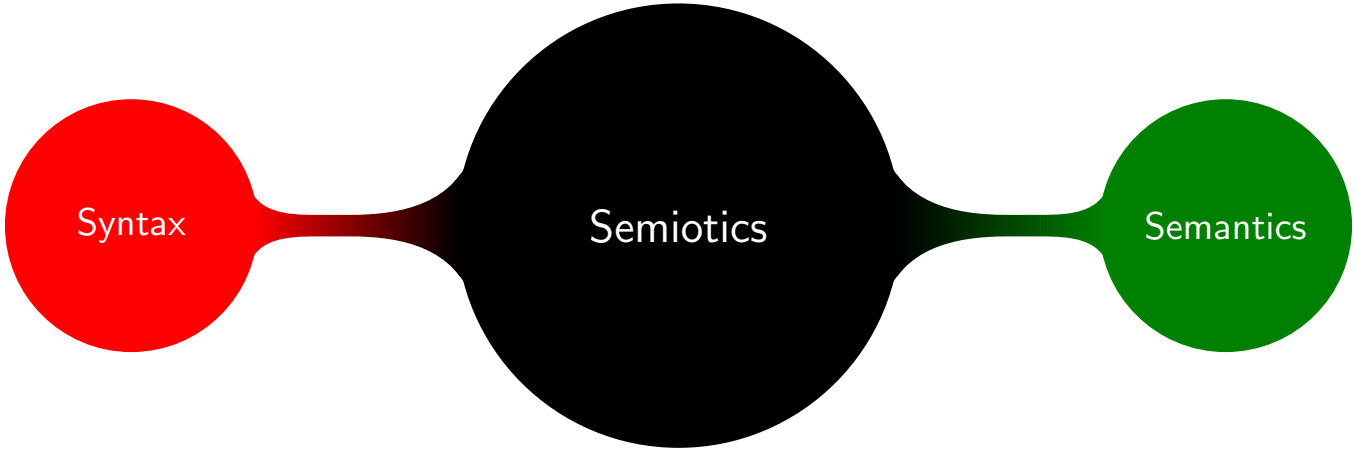
$+$

Semantics: relations between signs and the things they refer to

$=$

Semiotics: how meaning is constructed and understood

(Charles Morris, *Foundation of the Theory of Signs*, 1938)


Syntax
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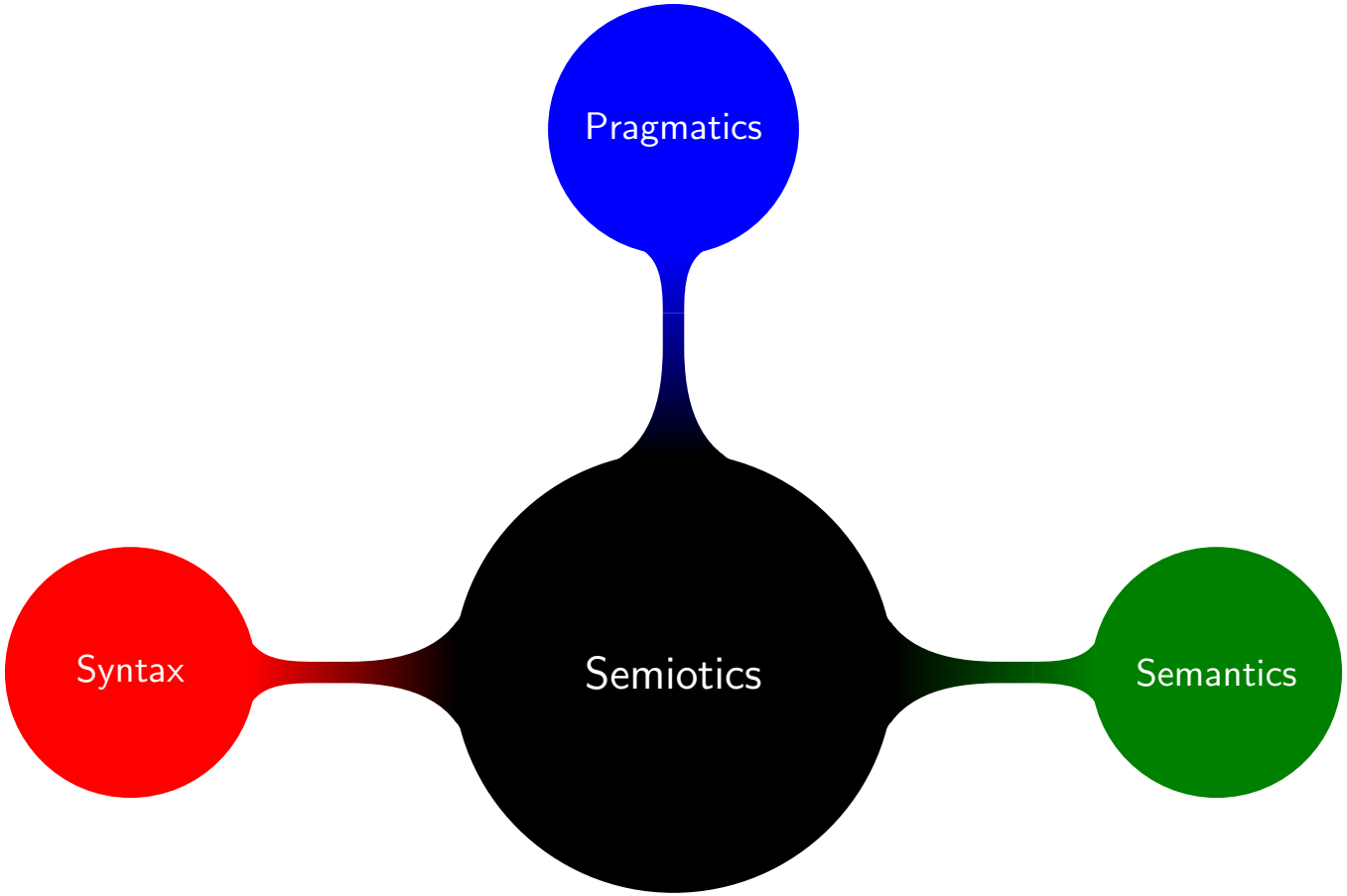
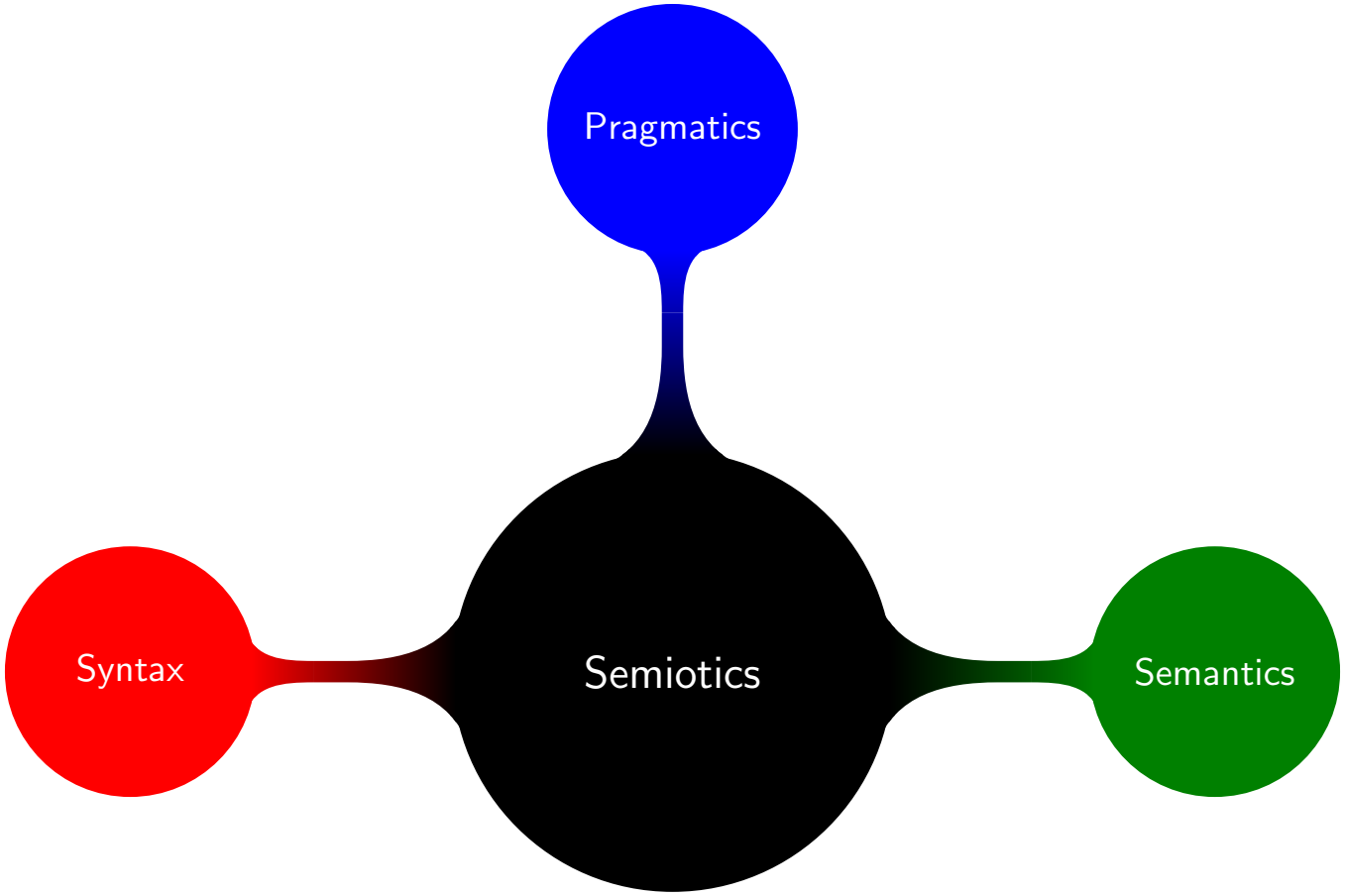


Modeling pragmatics $=_{def}$ practical issues of model creation, editing, browsing, versioning, ...

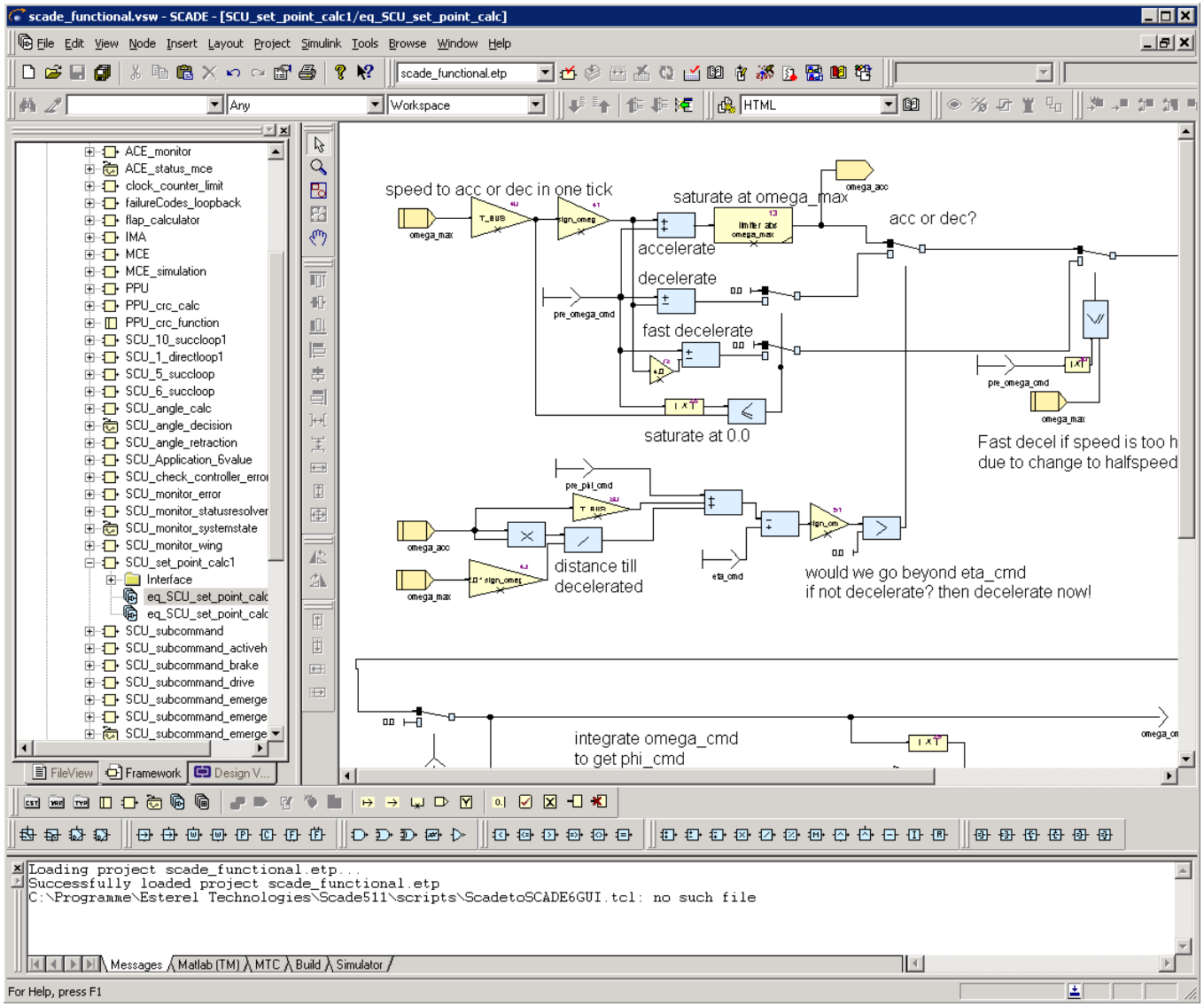


Modeling pragmatics $=_{def}$ practical issues of model creation, editing, browsing, versioning, ...

Pragmatics-aware modeling $=_{def}$ model-driven engineering with specific support for designer productivity

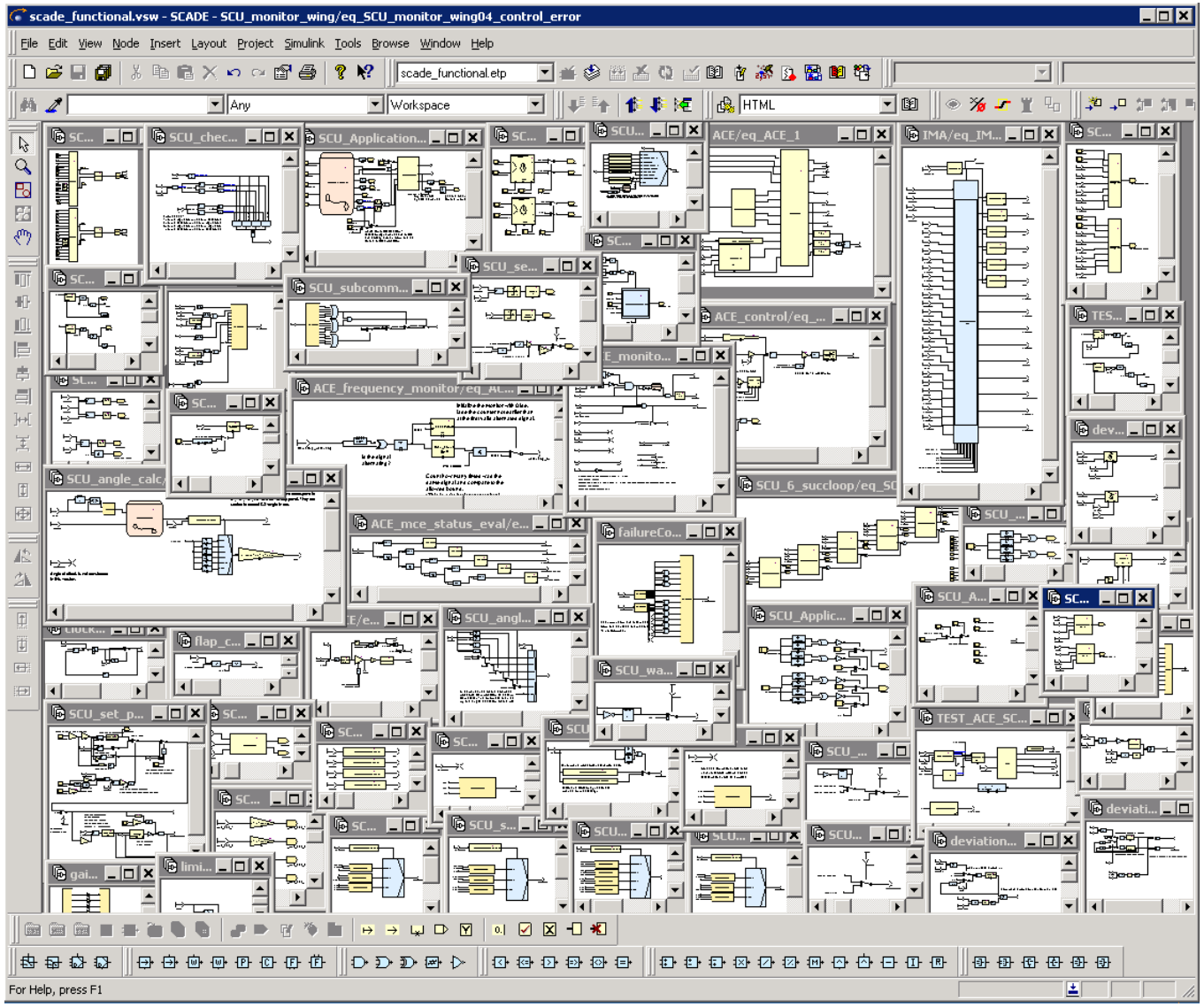
Pragmatics-Unaware Modeling

Context missing



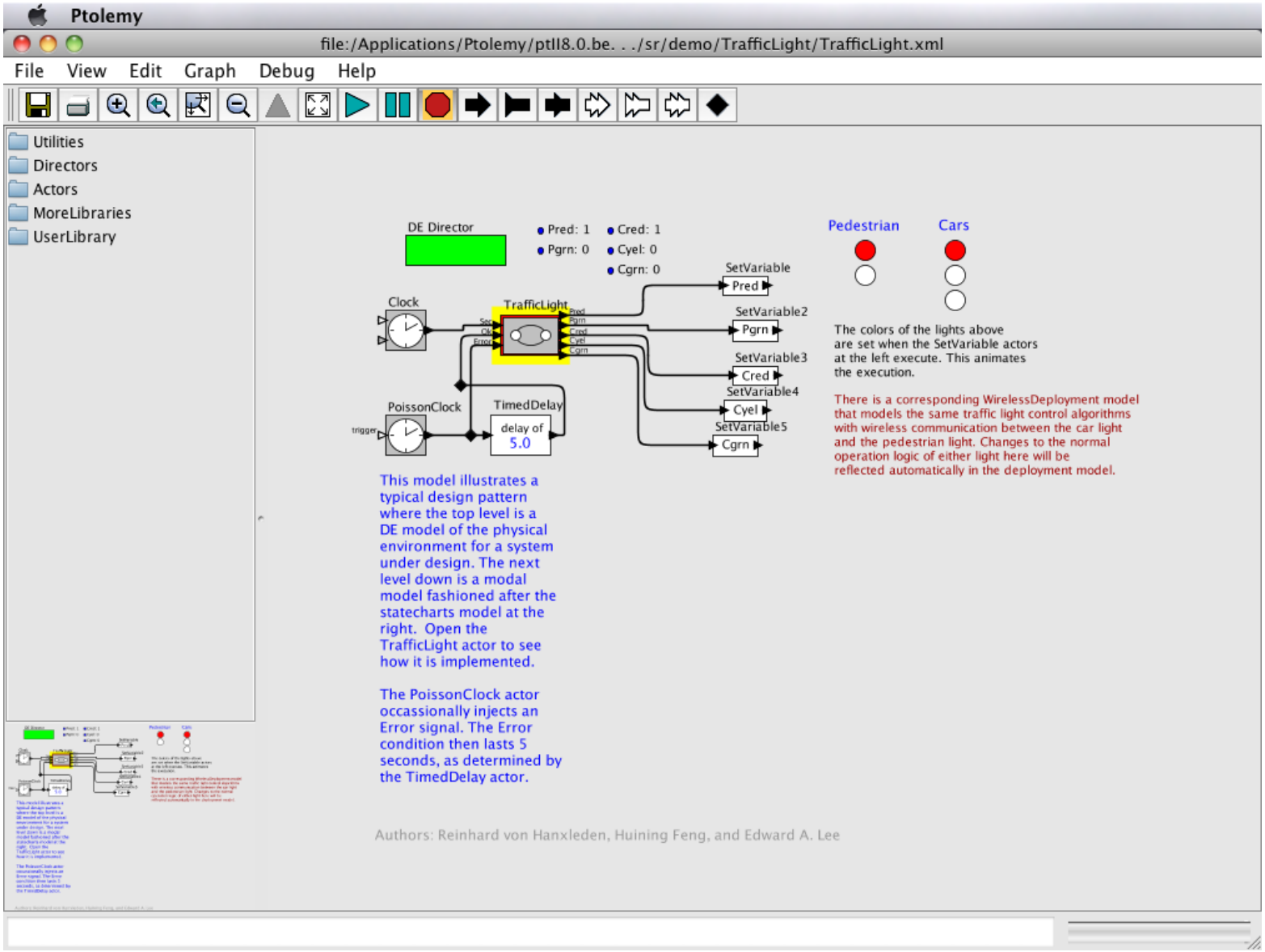
Pragmatics-Unaware Modeling

Quickly loose details



Pragmatics-Unaware Modeling

Lack of overview, tedious window management



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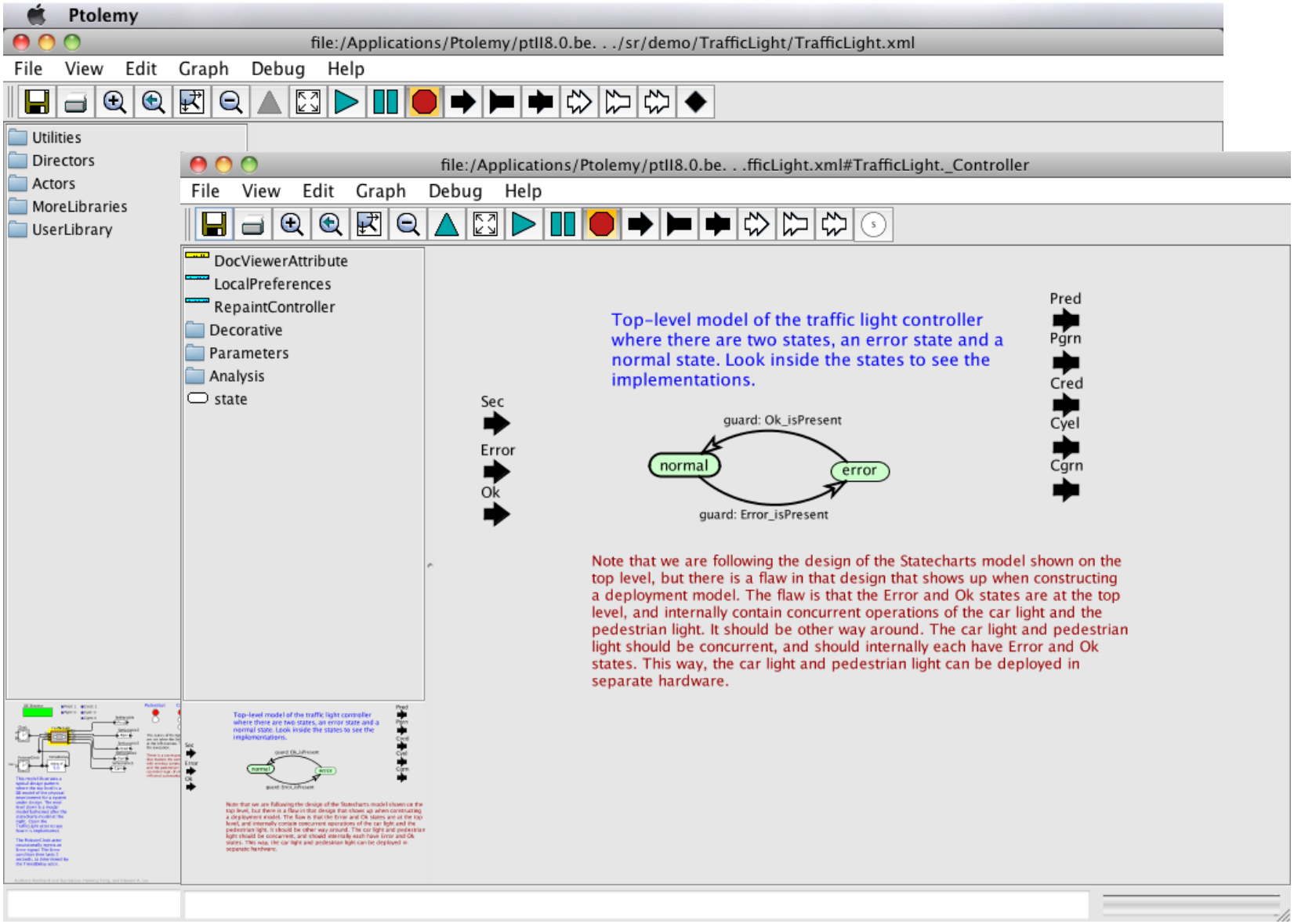

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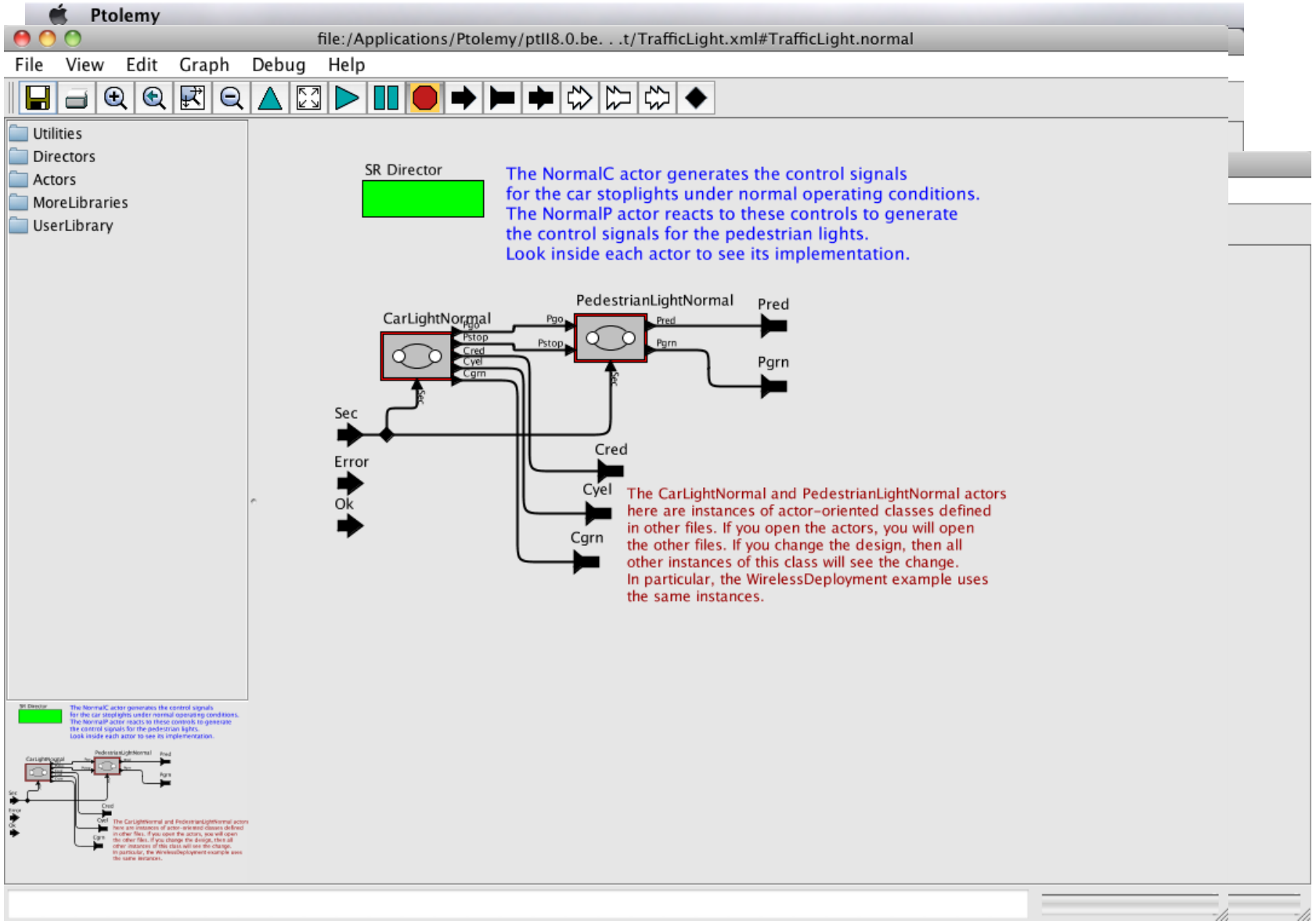

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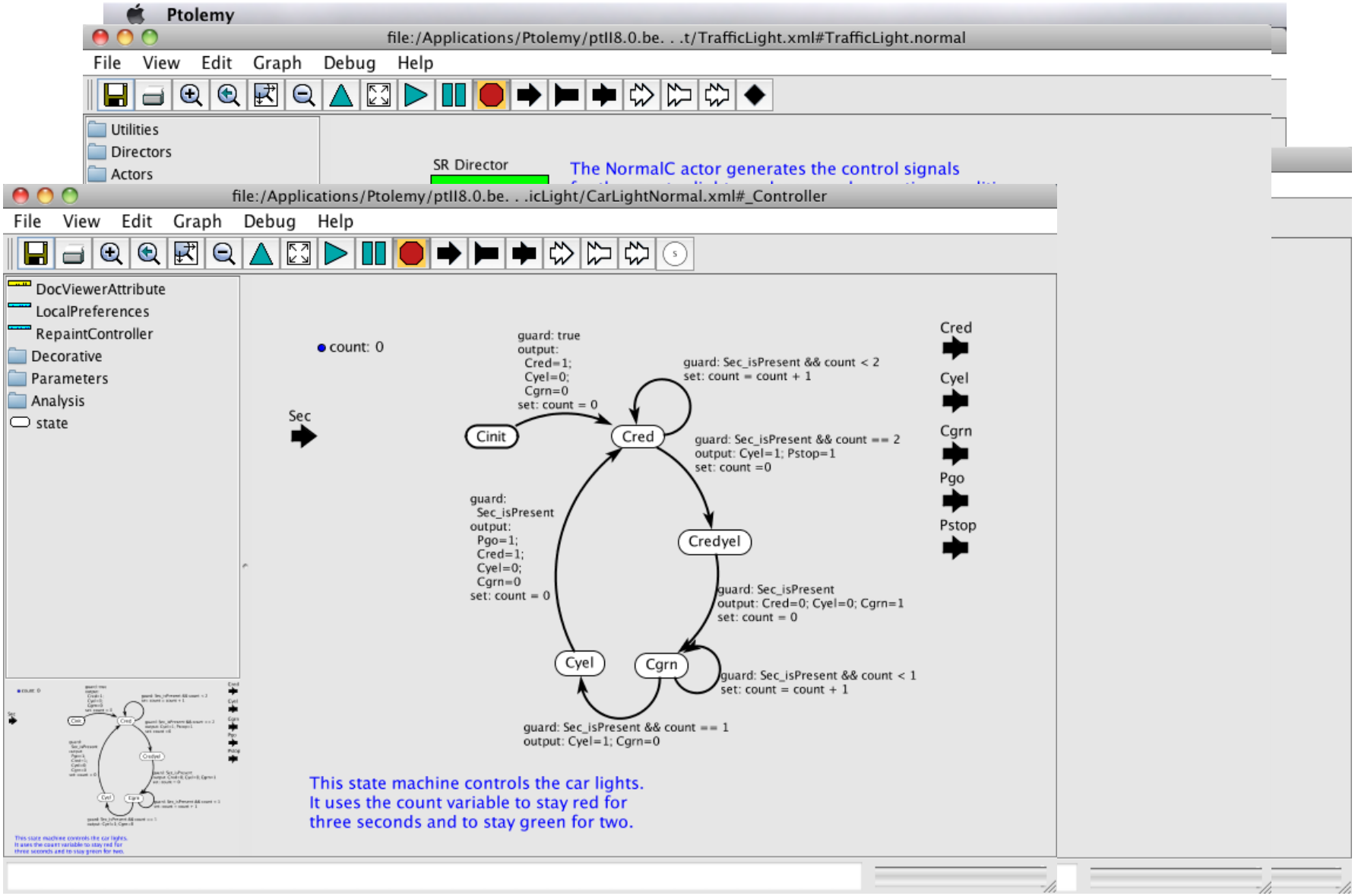

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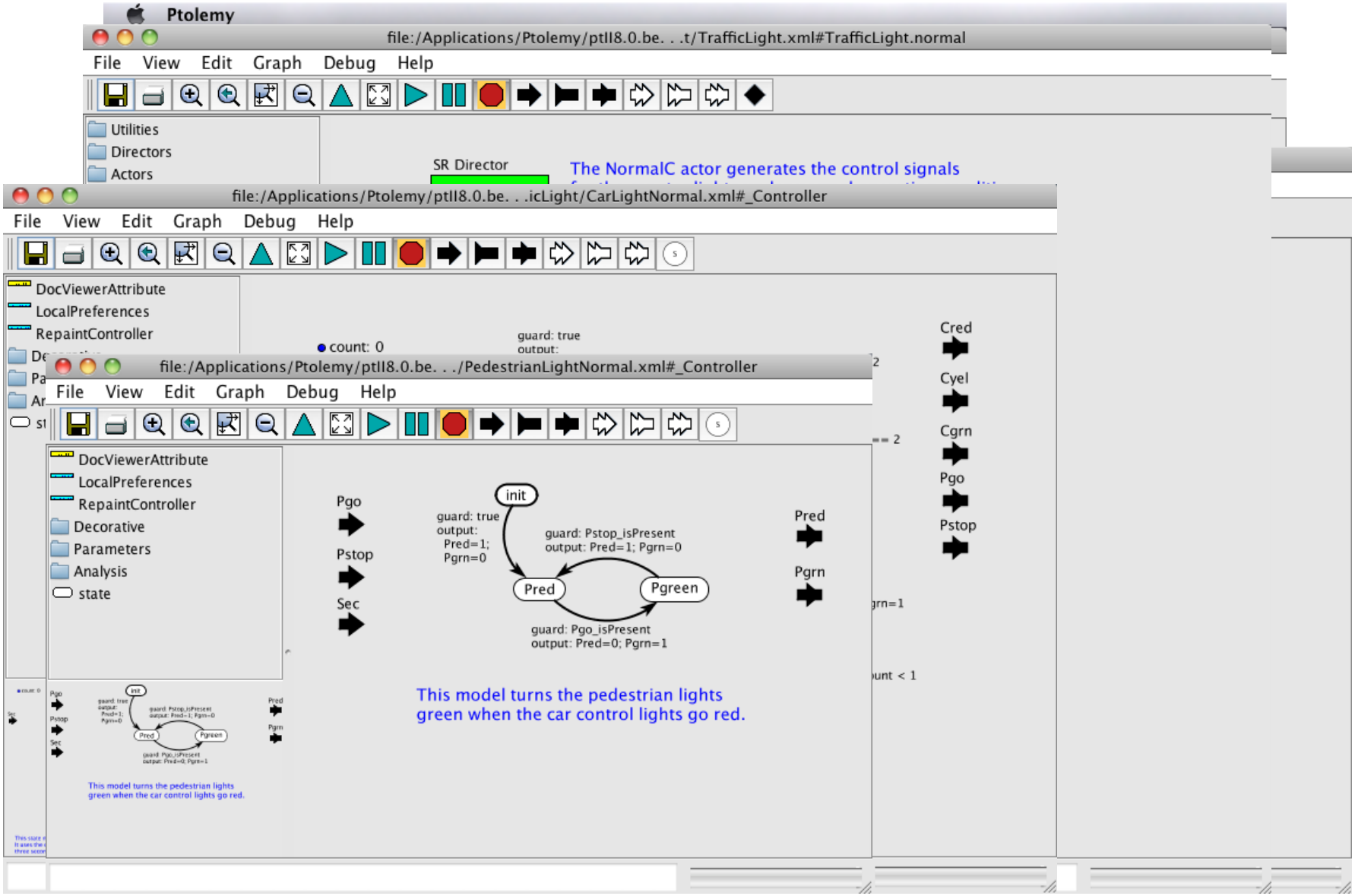

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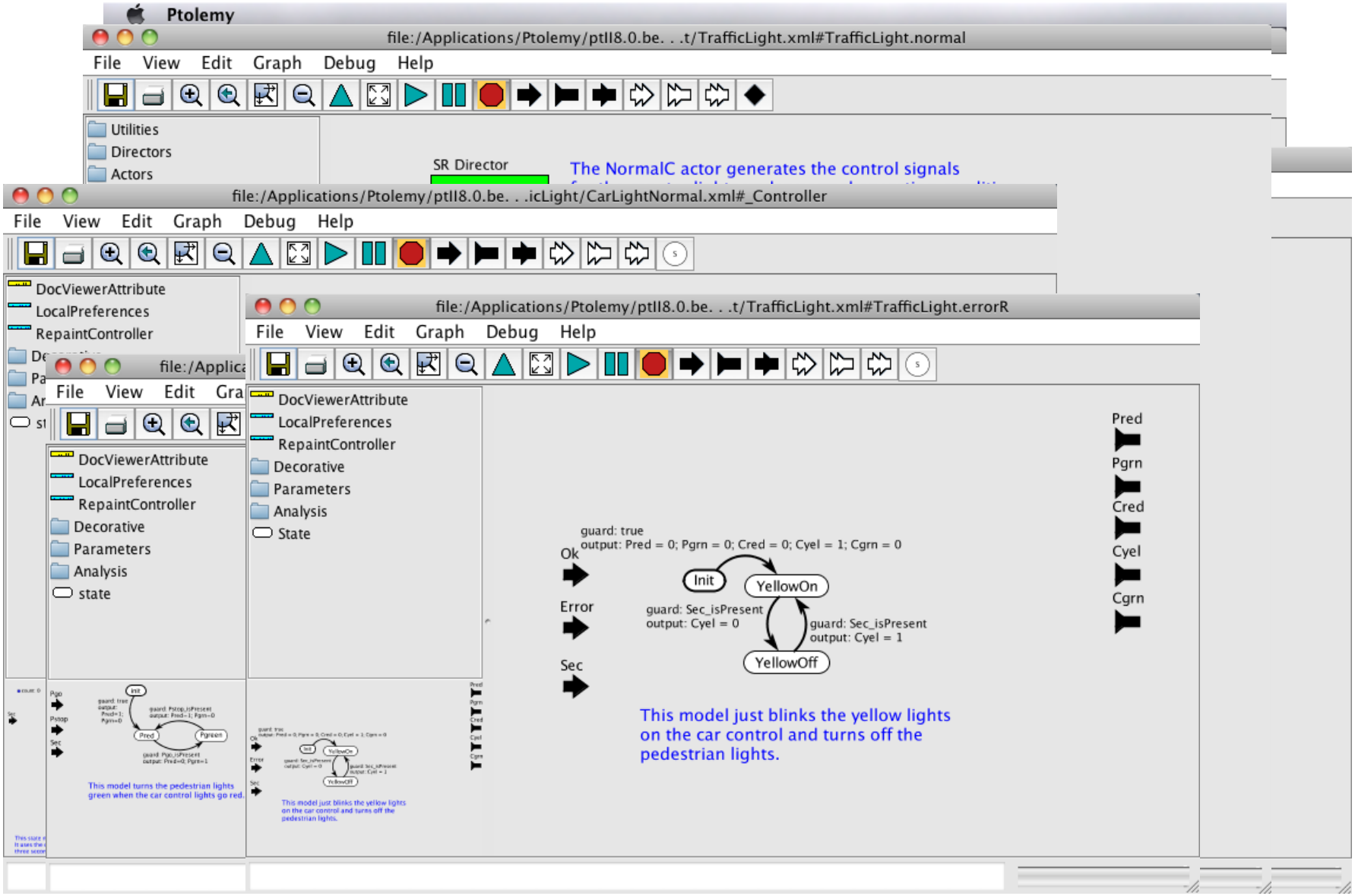
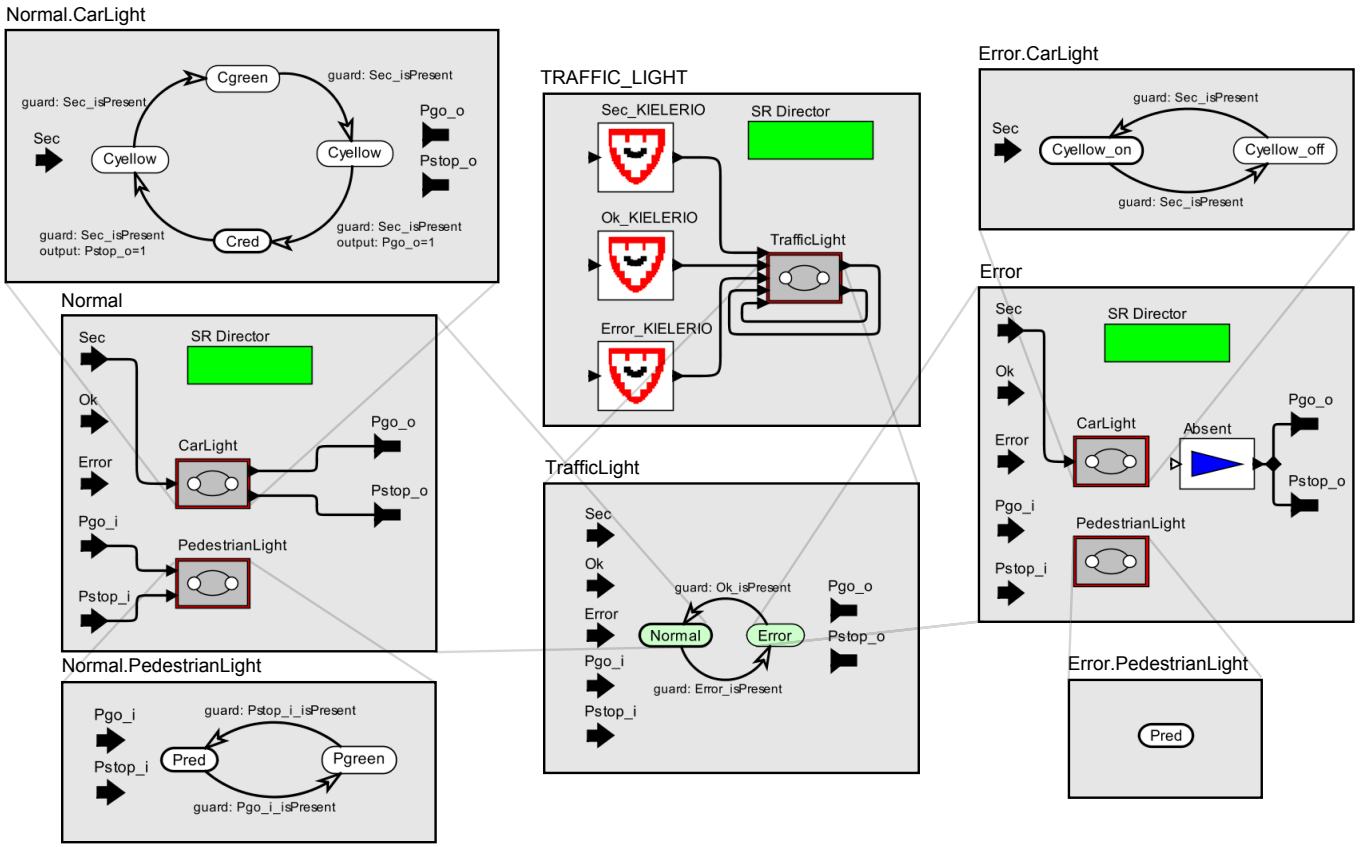


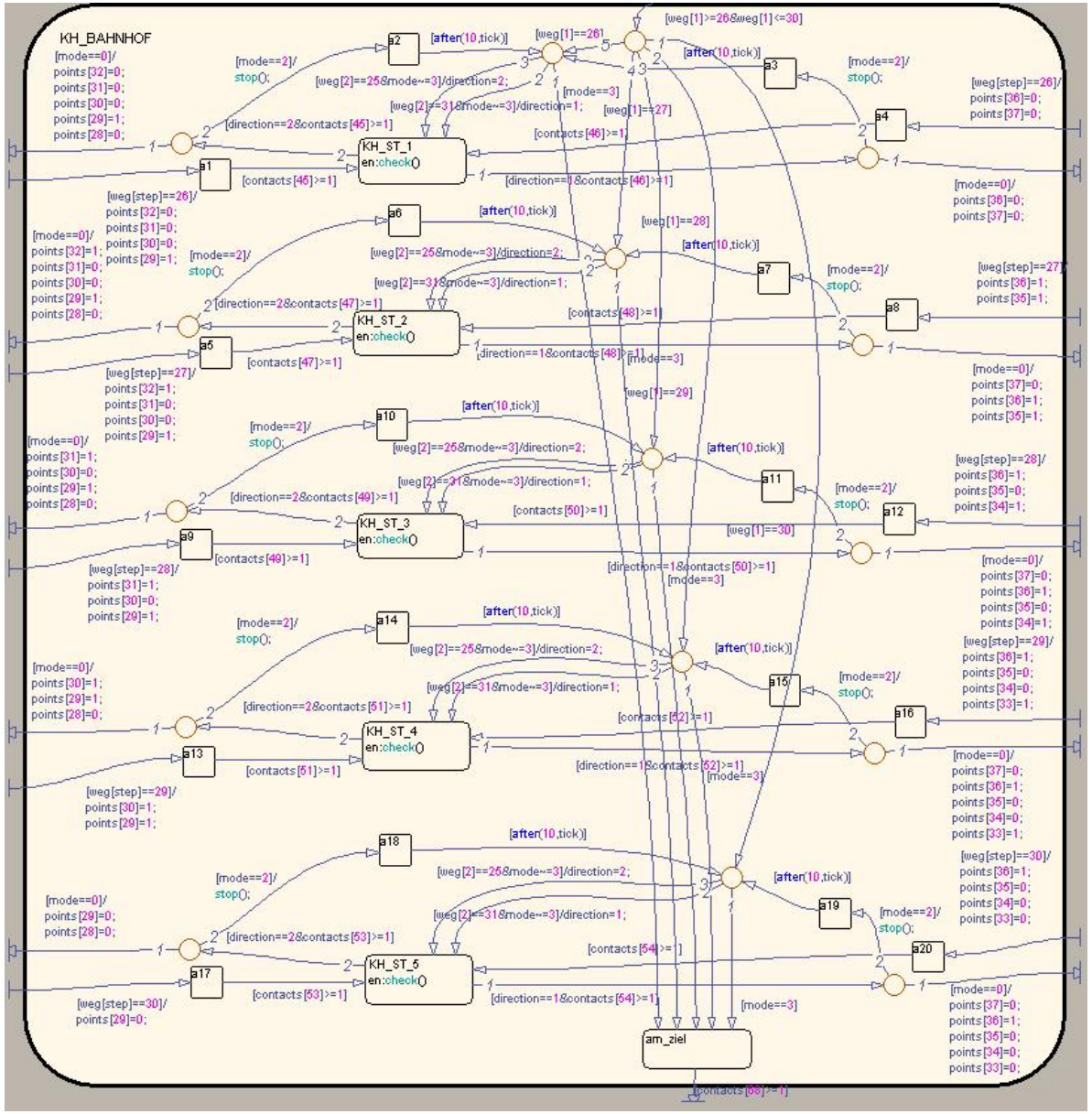
Pragmatics-Unaware Modeling

Better overview, but high manual effort



Pragmatics-Unaware Modeling

Diagrams difficult to read



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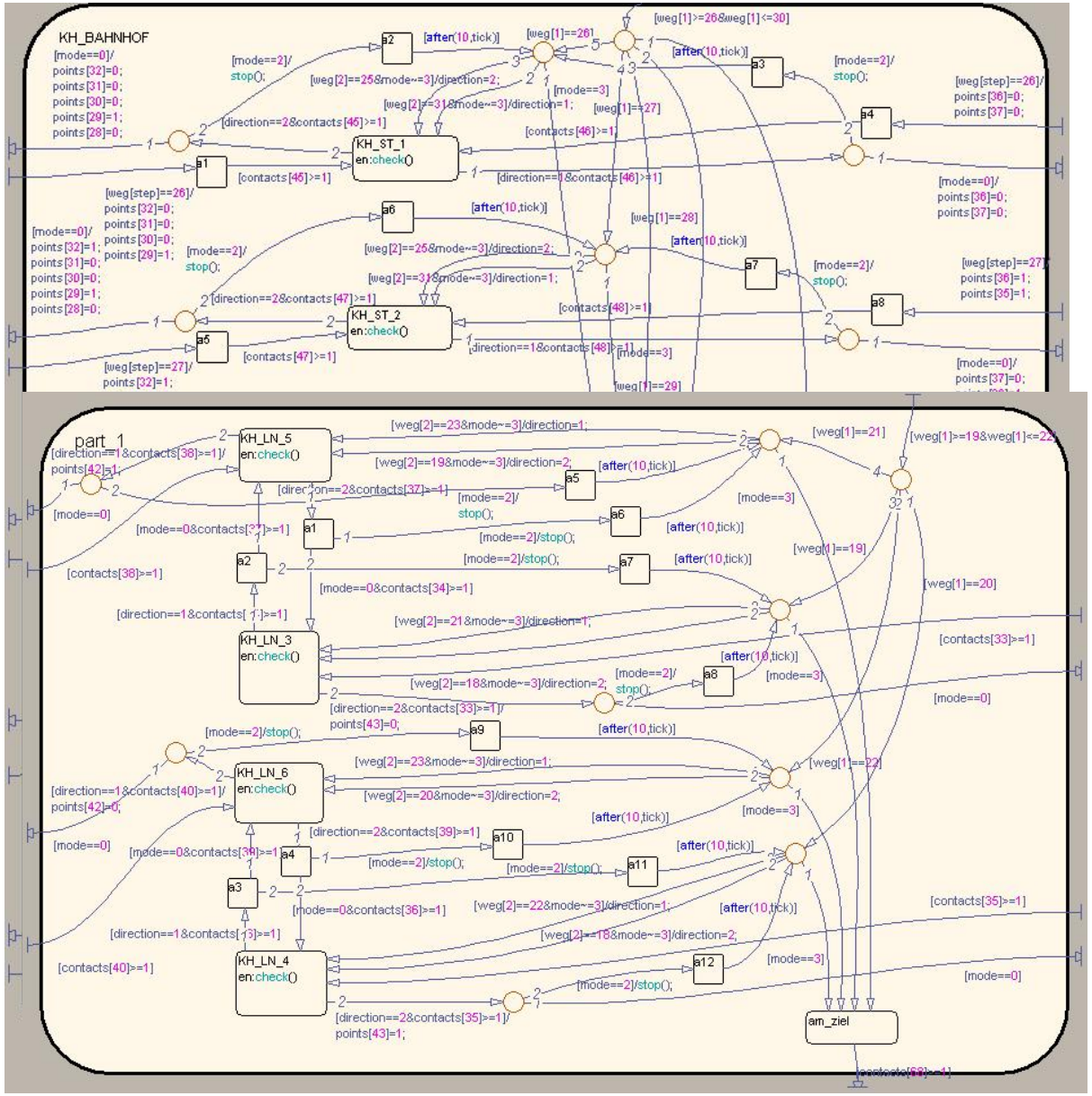

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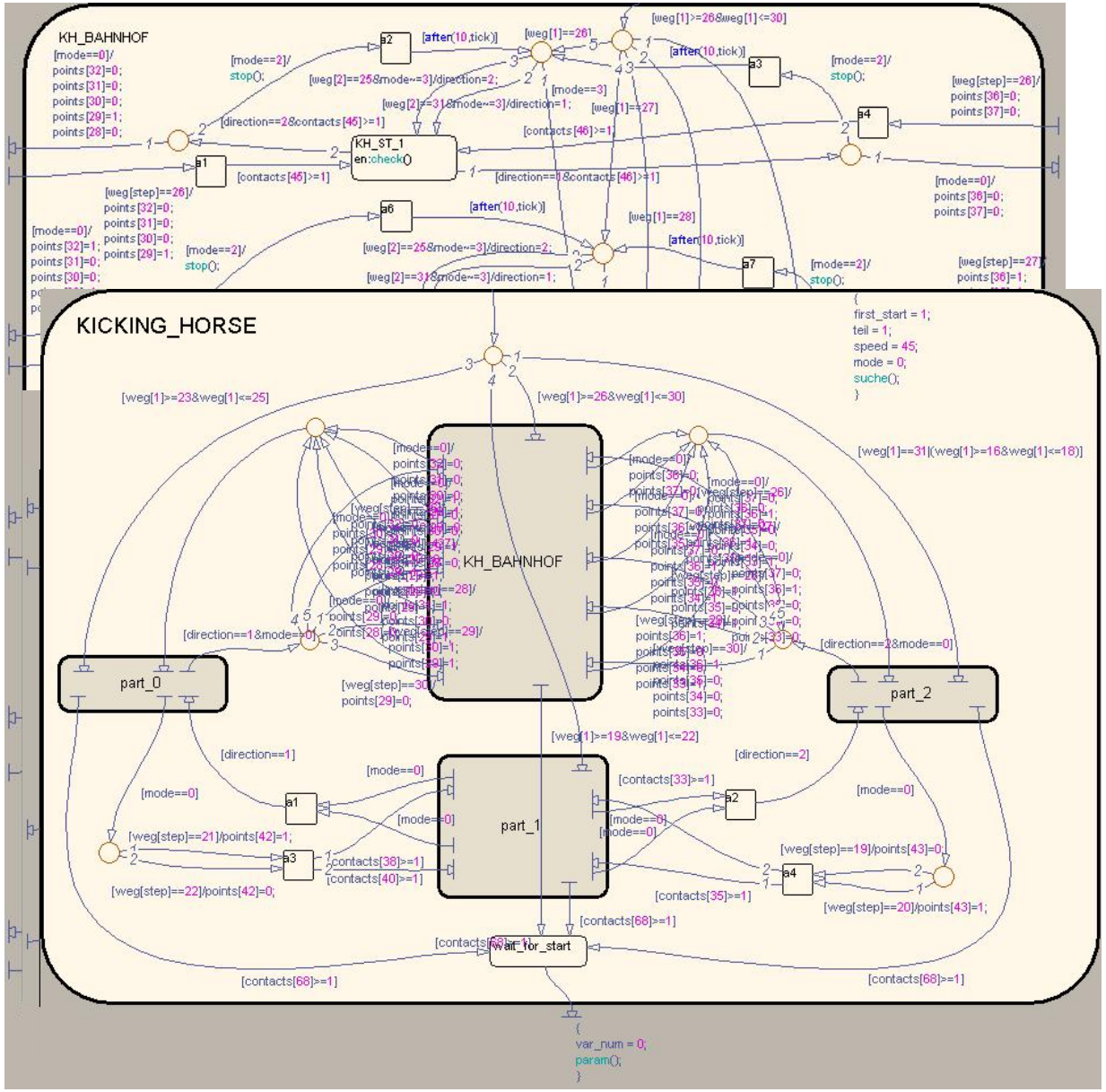
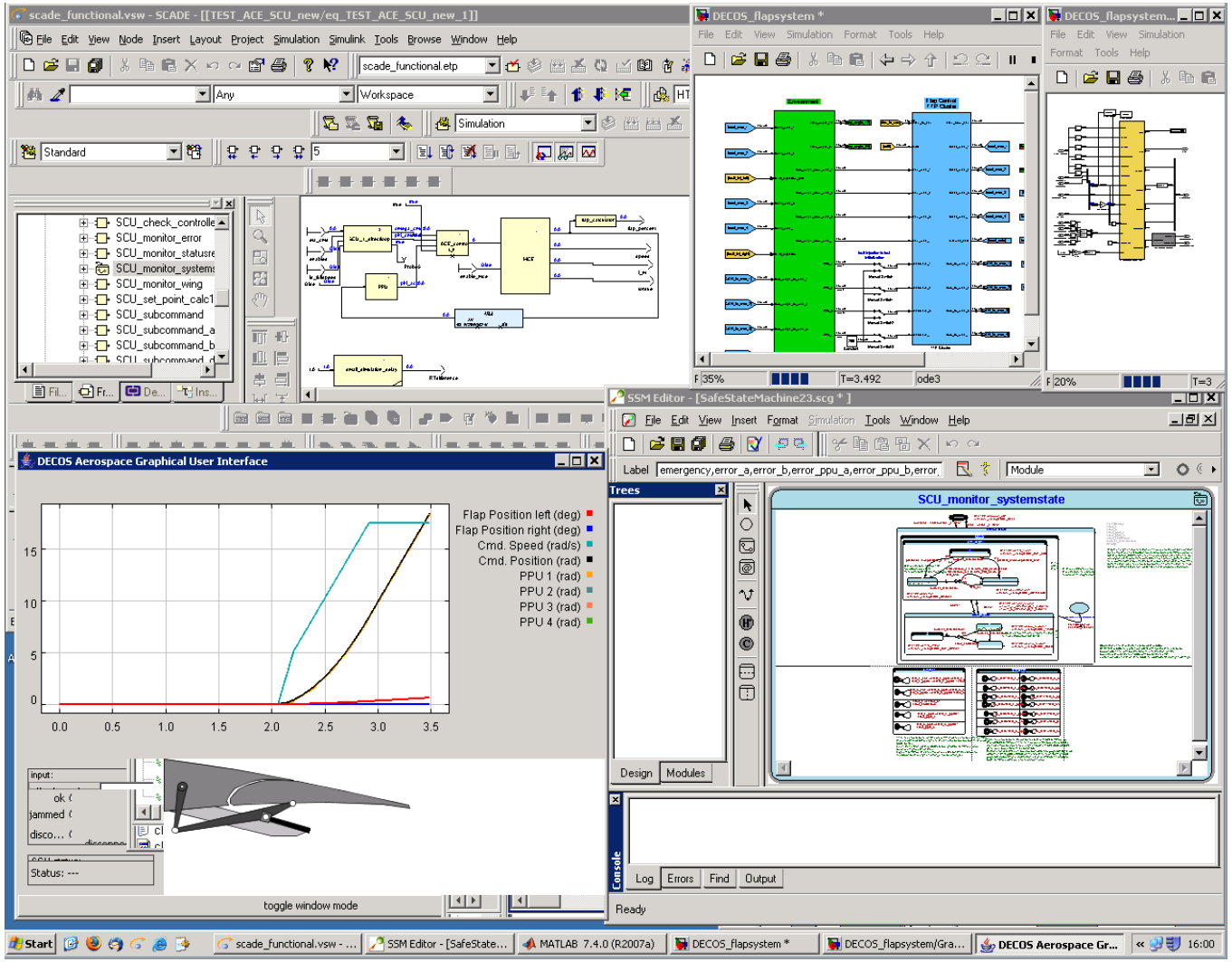


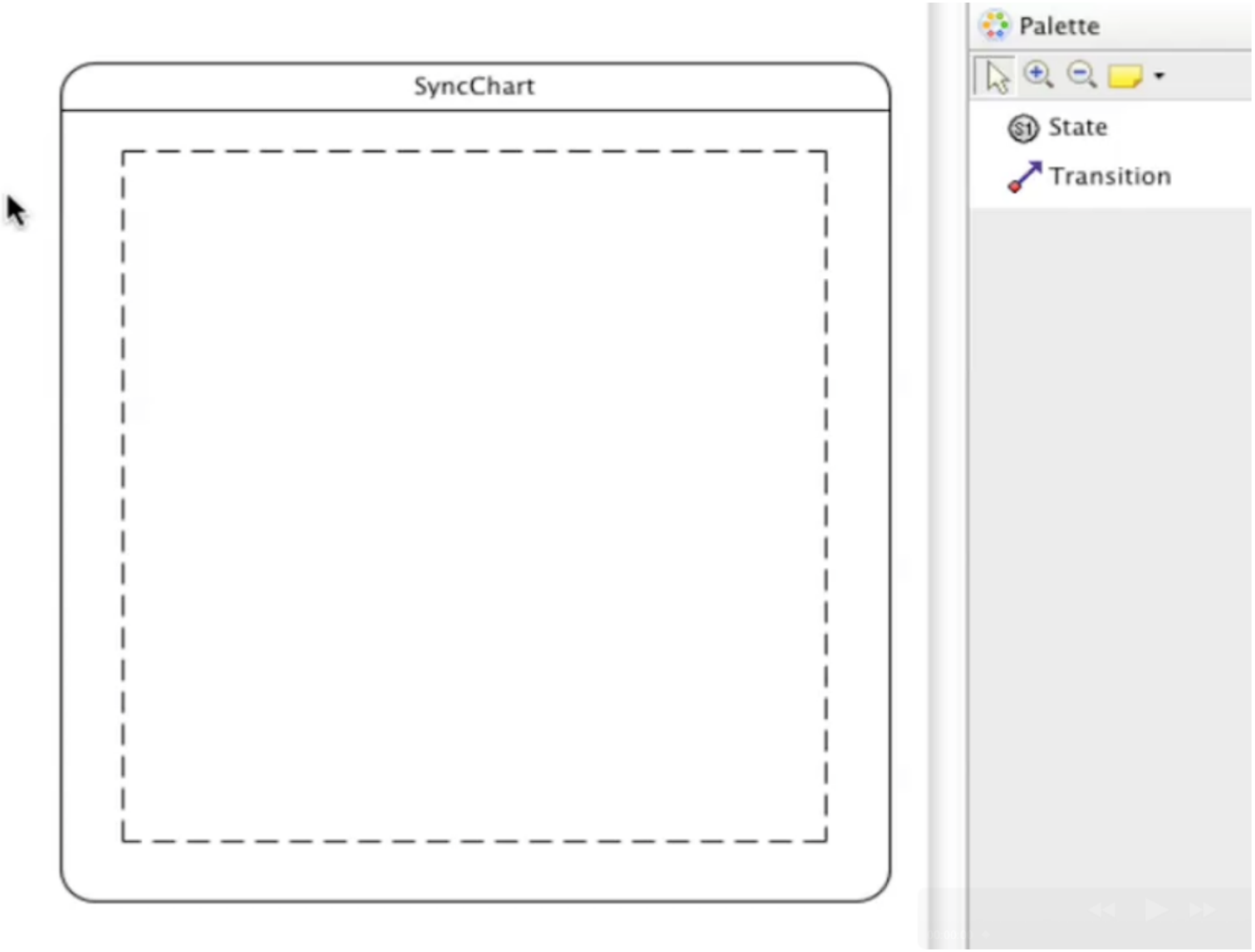
Pragmatics-Unaware Modeling

Overloaded screen real-estate



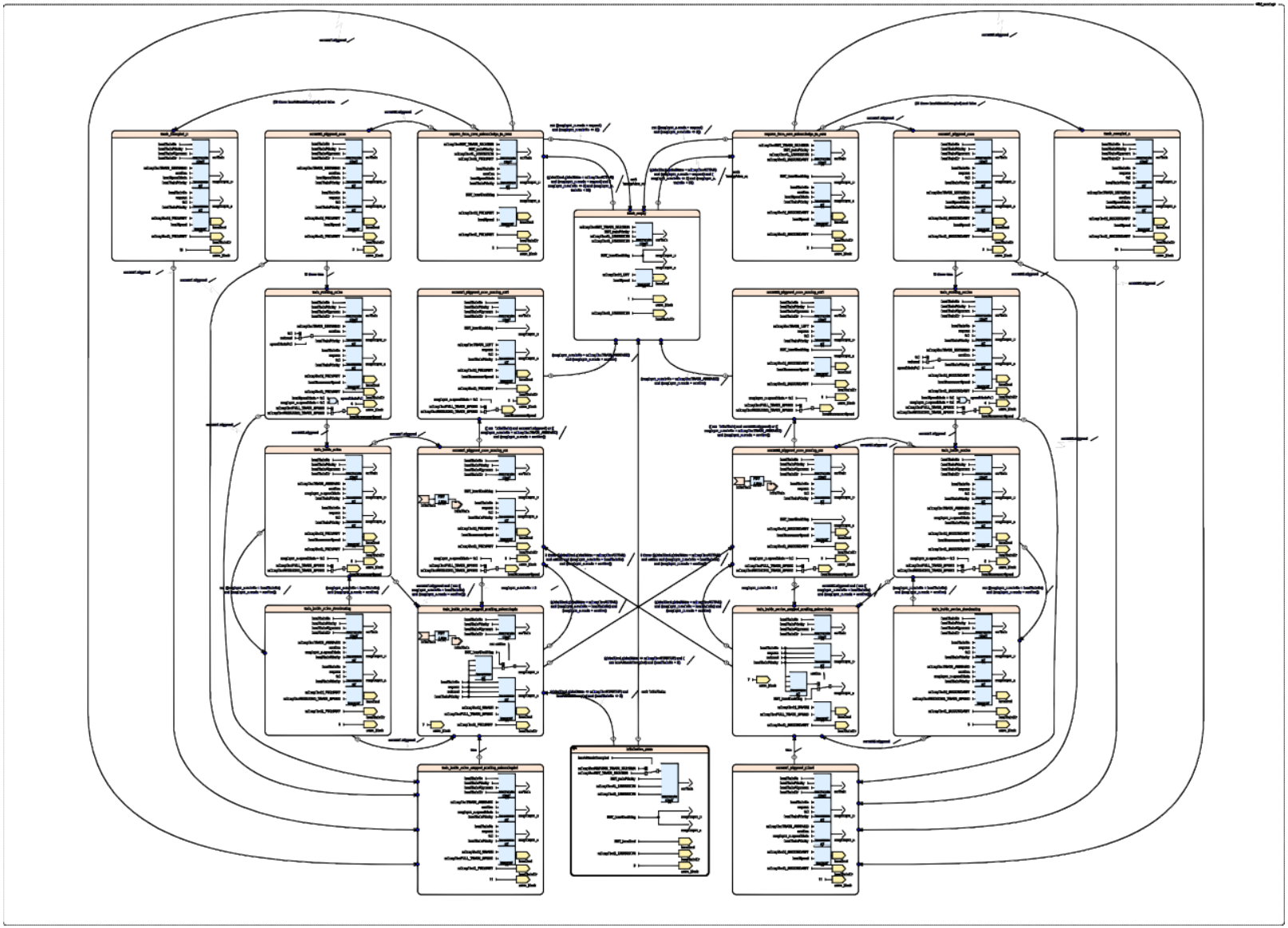
Pragmatics-Unaware Modeling

Painful editing technology



Pragmatics-Unaware Modeling

Manual effort increases significantly with model complexity



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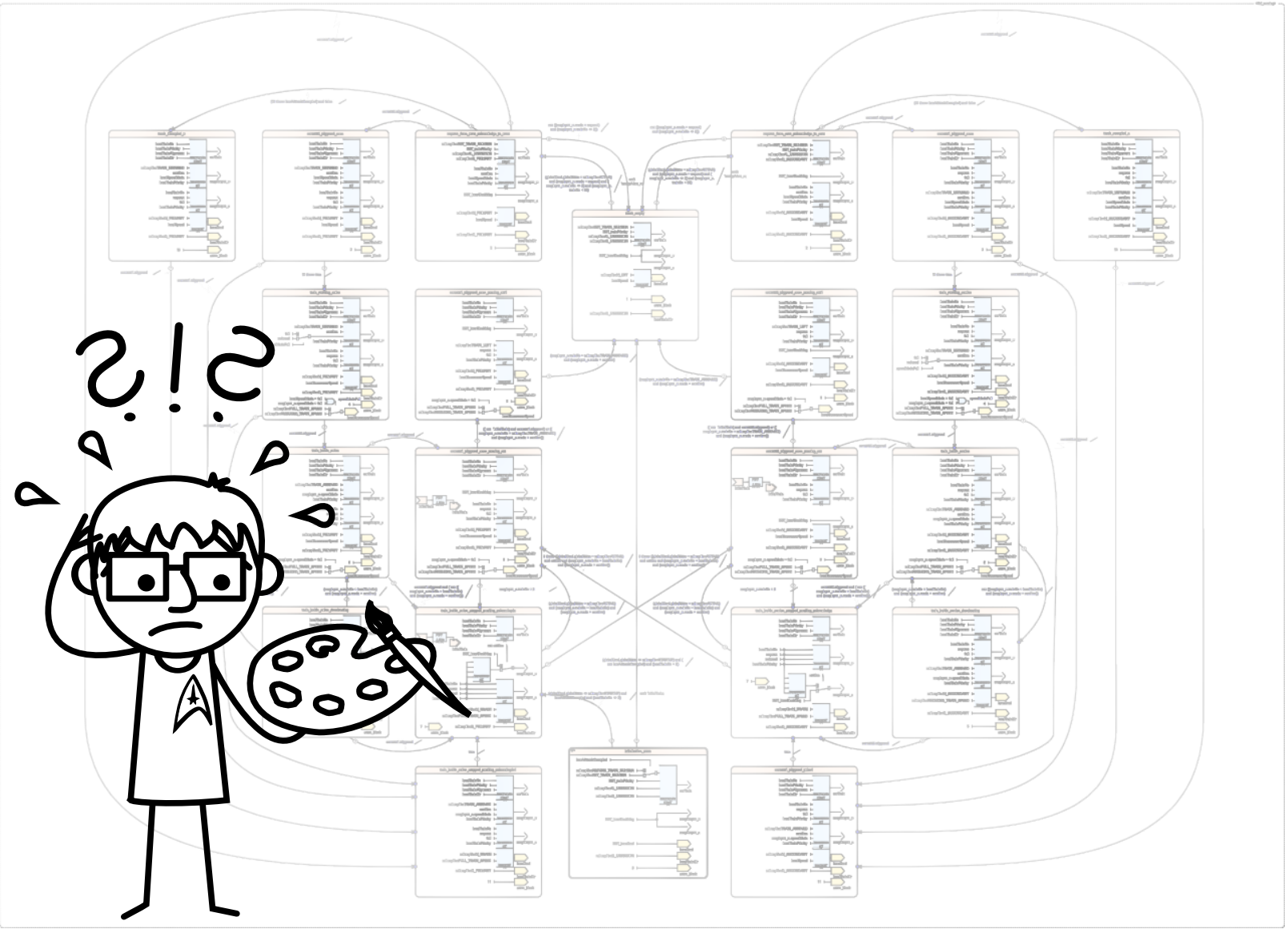

Are Textual DSLs the Answer?

Resource – VERA/GA/WeichenkontrolleUmstell12.logic – MENGES IDE – /Users/chsch/menges-workspace

*WeichenkontrolleUmstell12.logic

```
56  /** Ein berechtigtes Kommando zum Hilfsumstellen ist eingetroffen. */
57  from grund
58    if (hilfsUm()) then
59     change to hUml;
60
61  /** Ein berechtigtes Kommando zum Einzelsumstellen ist eingetroffen. */
62  from grund
63    if (!hilfsUm() && umEin()) then
64     change to uml;
65
66  /** Ein berechtigtes Kommando zum Stellen nach Rechts durch Befahrpunkt ist eingetroffen. */
67  from grund
68    if (hilfsUm() && !umEin() && umBpR() && !umBpL()) then
69     change to bPRe;
70
71  /** Ein berechtigtes Kommando zum Stellen nach Links durch Befahrpunkt ist eingetroffen. */
72  from grund
73    if (hilfsUm() && !umEin() && umBpL() && !umBpR()) then
74     change to bPLi;
75
76  /** Ein berechtigtes Kommando zum Stellen nach Rechts durch Fahrweg ist eingetroffen. */
77  from grund
78    if (!hilfsUm && !umEin && !umBpR && !umBpL && umFwR && !umFwL) then
79      change to fwLi;
```

Writable | Insert | 9 : 15

- Editing text much less tedious than editing graphics
- Revision control simpler
- Portable, tool independent

Still Want Graphical Views!

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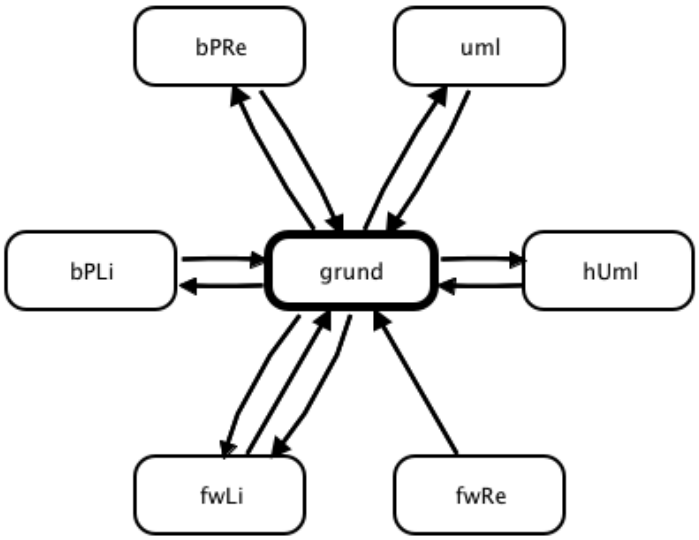
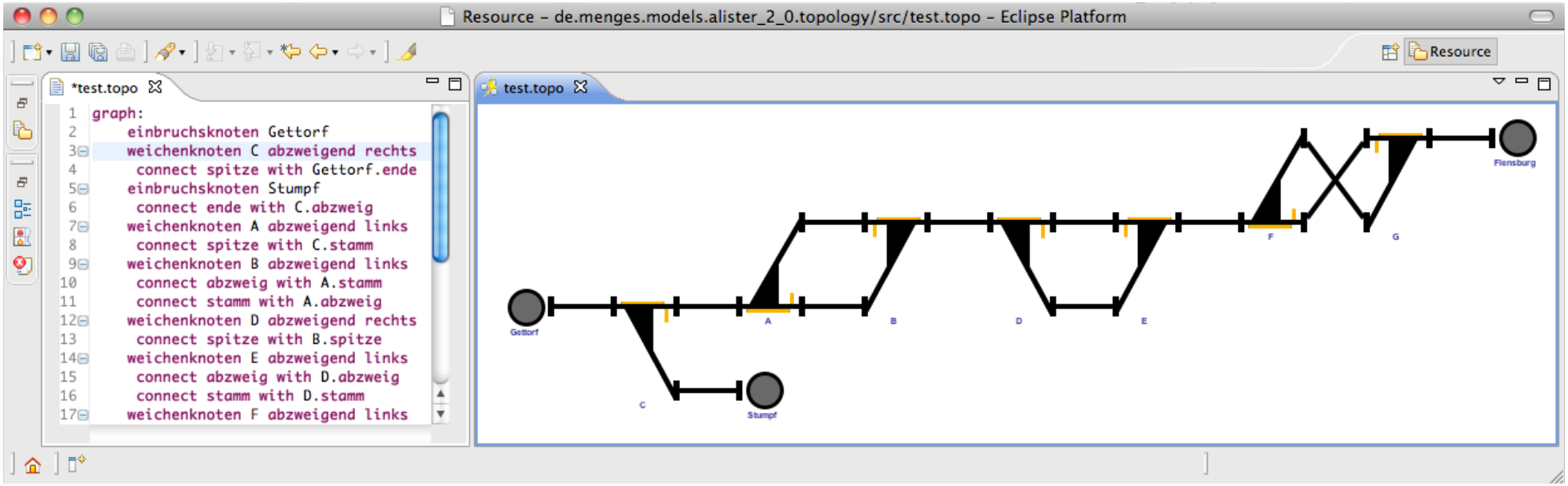


Writable | Insert | 9 : 15

- Text requires string matching to uncover structure
- Diagram makes structure obvious
- Unreachable state in model emerges

Still Want Graphical Views!



- Diagram uncovers specification flaw (upper right corner)

Pragmatics-Aware Modeling

Free user of tedious mechanical work, such as ...

- manual placing of graphical objects
- manual navigation in complex models

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Our experimental platform: KIELER
Kiel Integrated Environment for Layout Eclipse RichClient

The Model-View-Controller (MVC) Paradigm

Models Models represent knowledge. A model could be a single object (rather uninteresting), or it could be some structure of objects.

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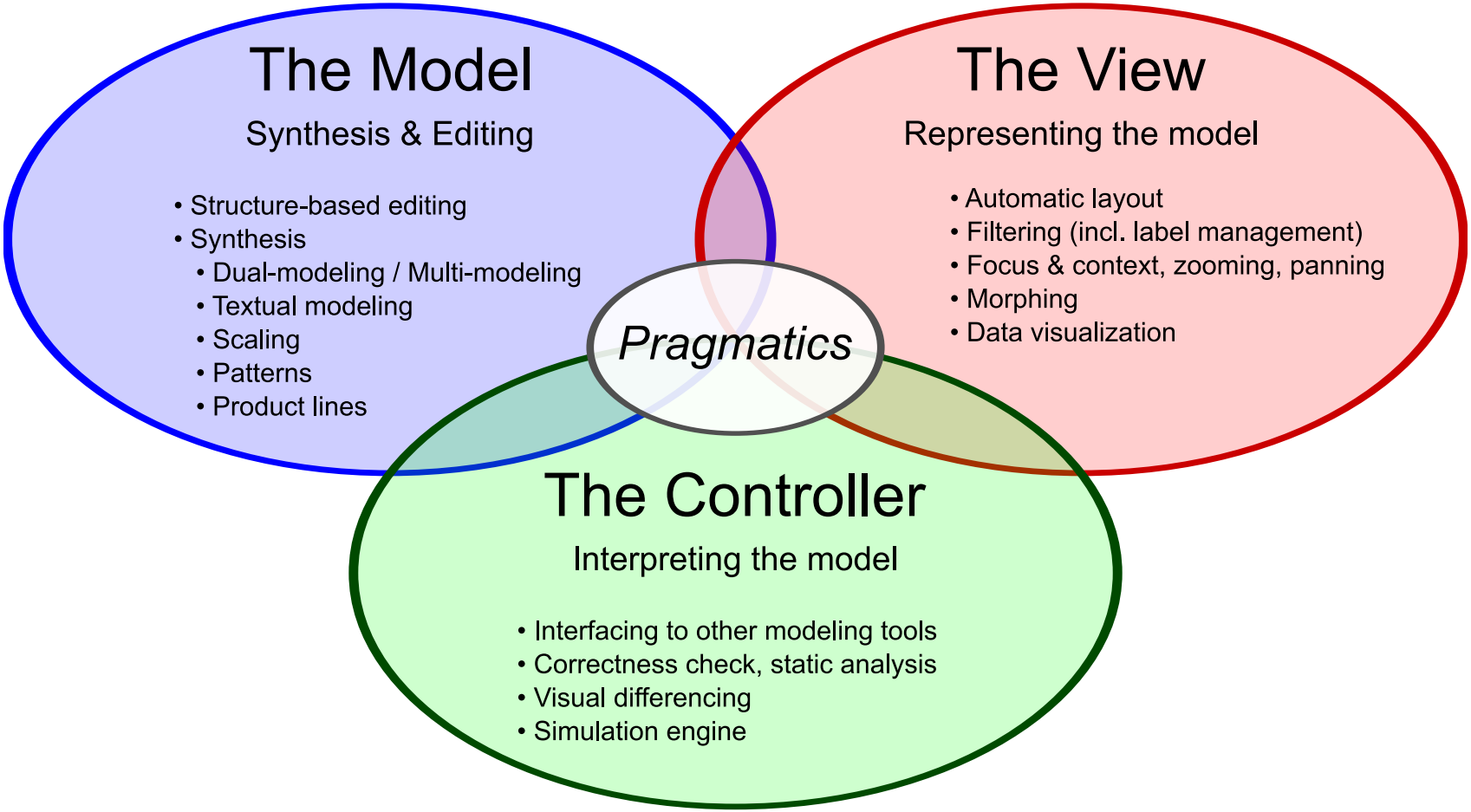
(Trygve Reenskaug, *Models – Views – Controllers*, Xerox PARC technical note, 1979)

A Key to Pragmatics: MVC



Fuhrmann, von Hanxleden
On the Pragmatics of Model-Based Design
15th Monterey Workshop 2008, LNCS 6028 (2010)

Overview

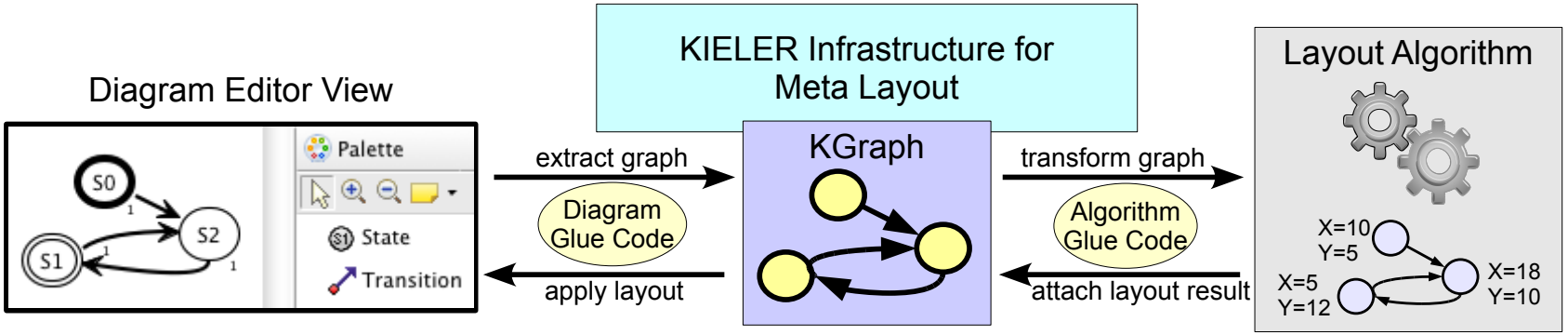
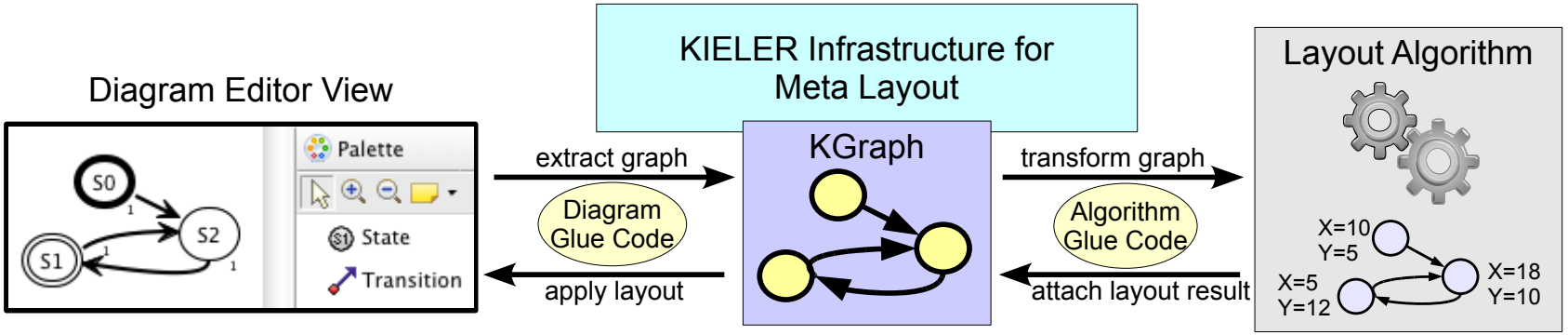
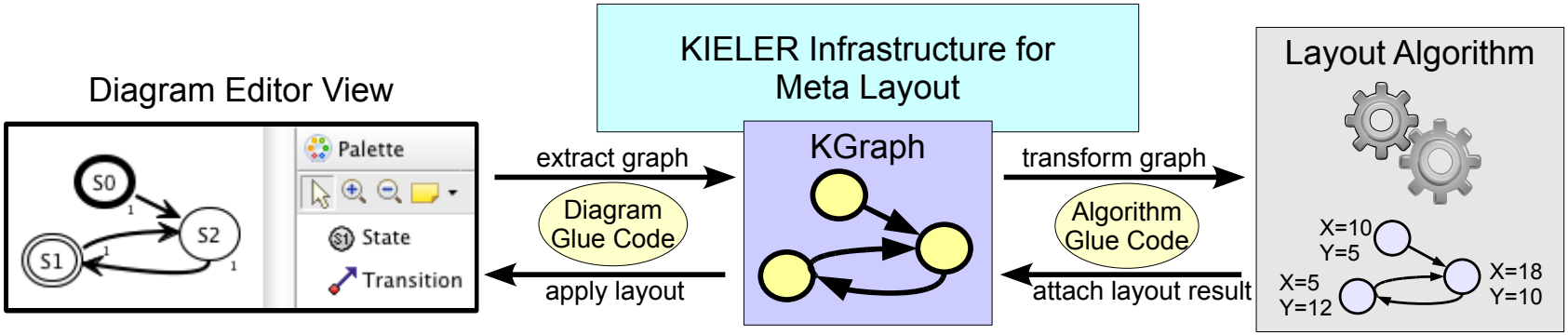


Diagram Editor View
S0
S1
S2
Palette
State
Transition
extract graph
Diagram Glue Code
apply layout
KIELER Infrastructure for Meta Layout
KGraph
transform graph
Algorithm Glue Code
attach layout result
Layout Algorithm
X=10
Y=5
X=5
Y=12
X=18
Y=10



- GMF
- Graphiti
- Papyrus
- Yakindu

- Graphviz (Dot, Neato, FDP, Twopi, Circo)
- Open Graph Drawing Framework (OGDF) (Layer-based, Planarization, Force-directed)
- Own Implementations (Data flow diagrams)



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Schulze, Spönemann, v. Hanxleden
Drawing Layered Graphs with Port Constraints
JVLC'14

Editing Efficiency: An Experiment

Task: create diagram from textual specification

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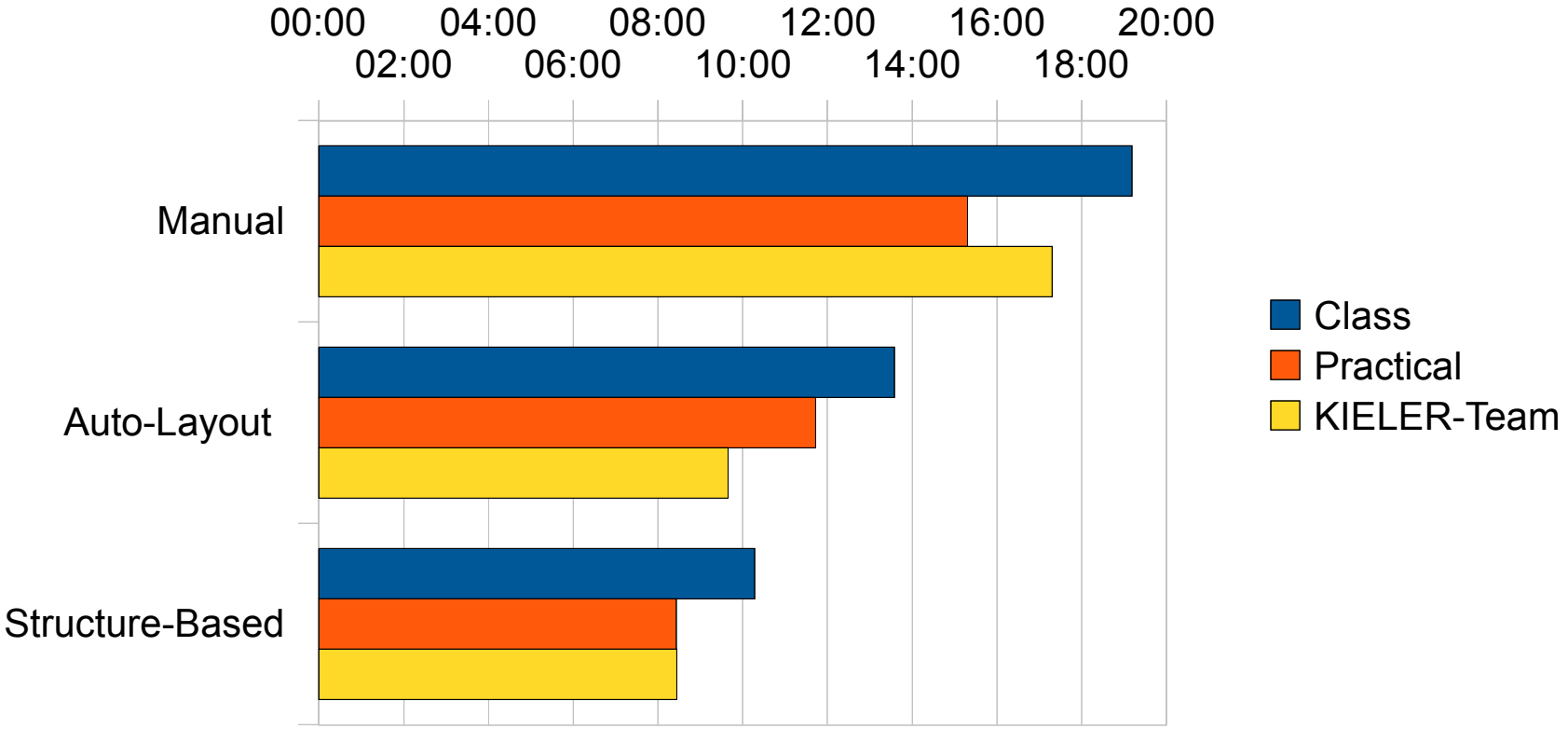
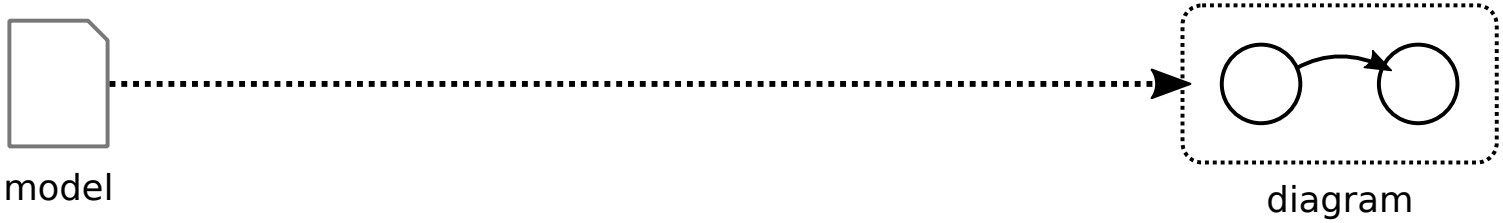


Fuhrmann, von Hanxleden
Taming Graphical Modeling
MODELS'10

KIELER Lightweight Diagrams (KLighD)

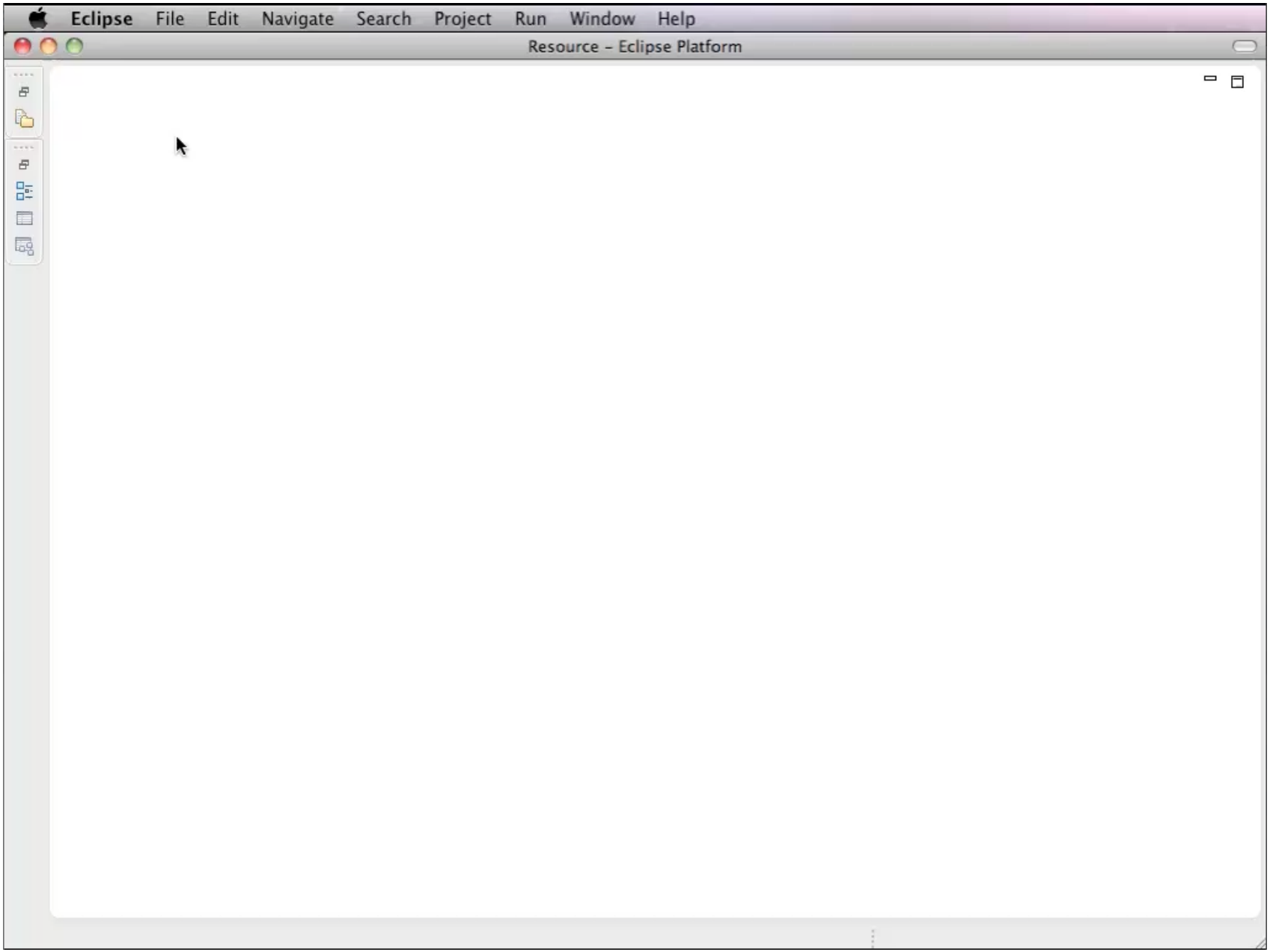


KIELER Lightweight Diagrams (KLighD)

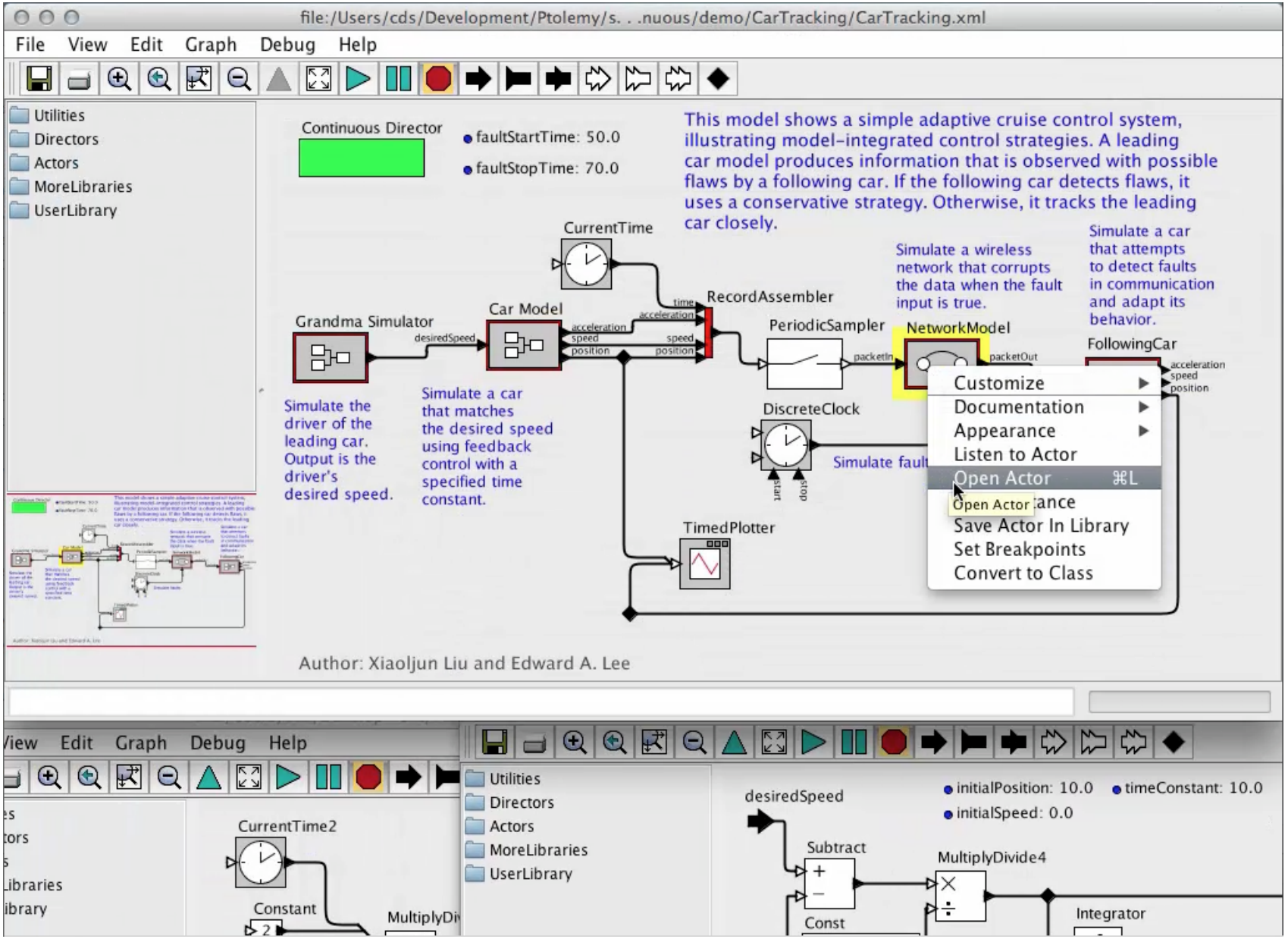
```
state machine {
  input signal POWER
  region:
    init state Off
    --> On with POWER;
    state On;
};
```

diagram

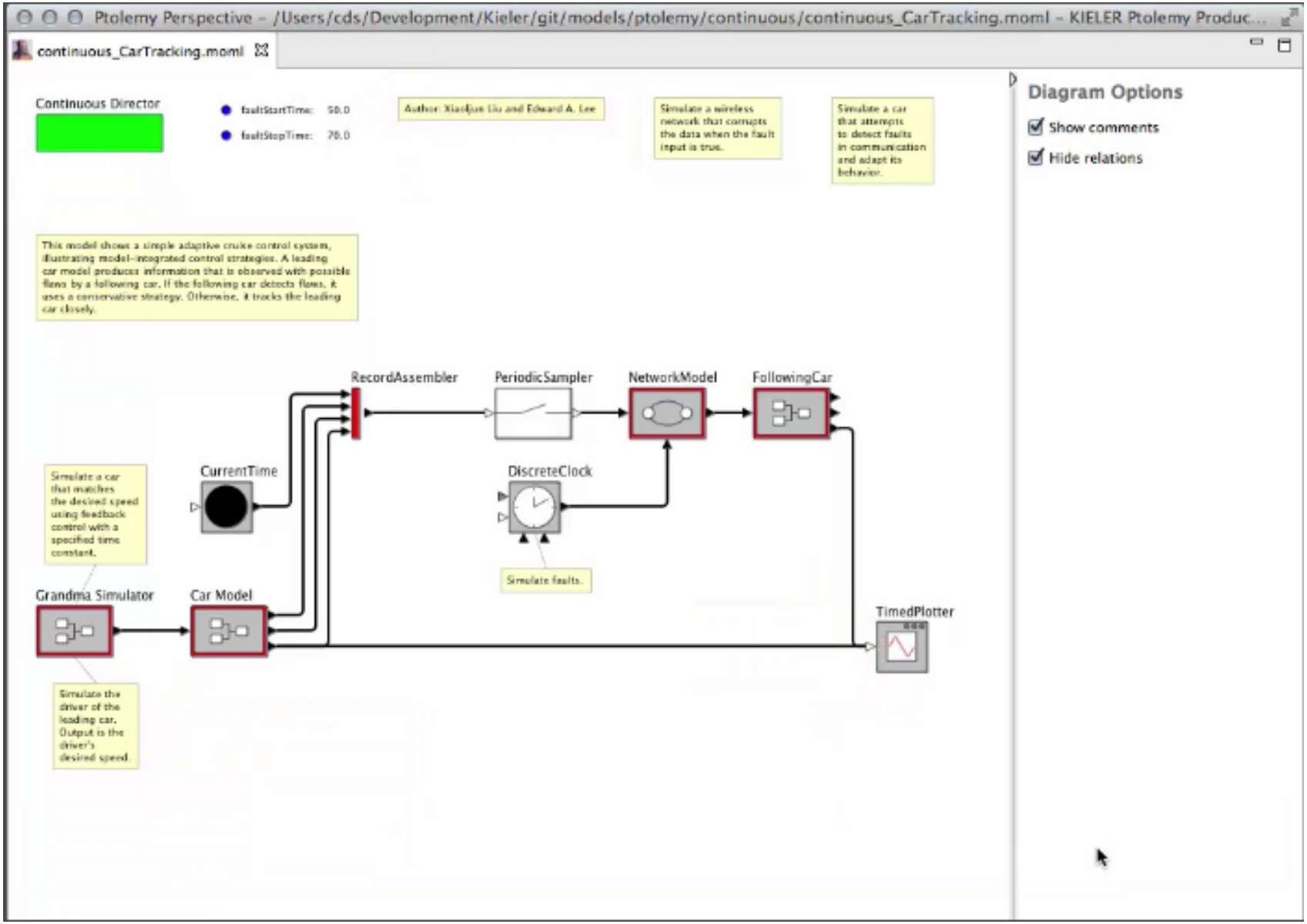
KIELER Lightweight Diagrams (KLighD)


Eclipse
File
Edit
Navigate
Search
Project
Run
Window
Help
Resource - Eclipse Platform

Ptolemy (UC Berkeley)



Ptolemy Browser (Based on KLighD)



Lightweight Diagrams: Building blocks

- Automatic arrangement of depicted elements – macro layout
- Local arrangement of the figures' primitives – micro layout
- A description language to formulate diagrams smartly

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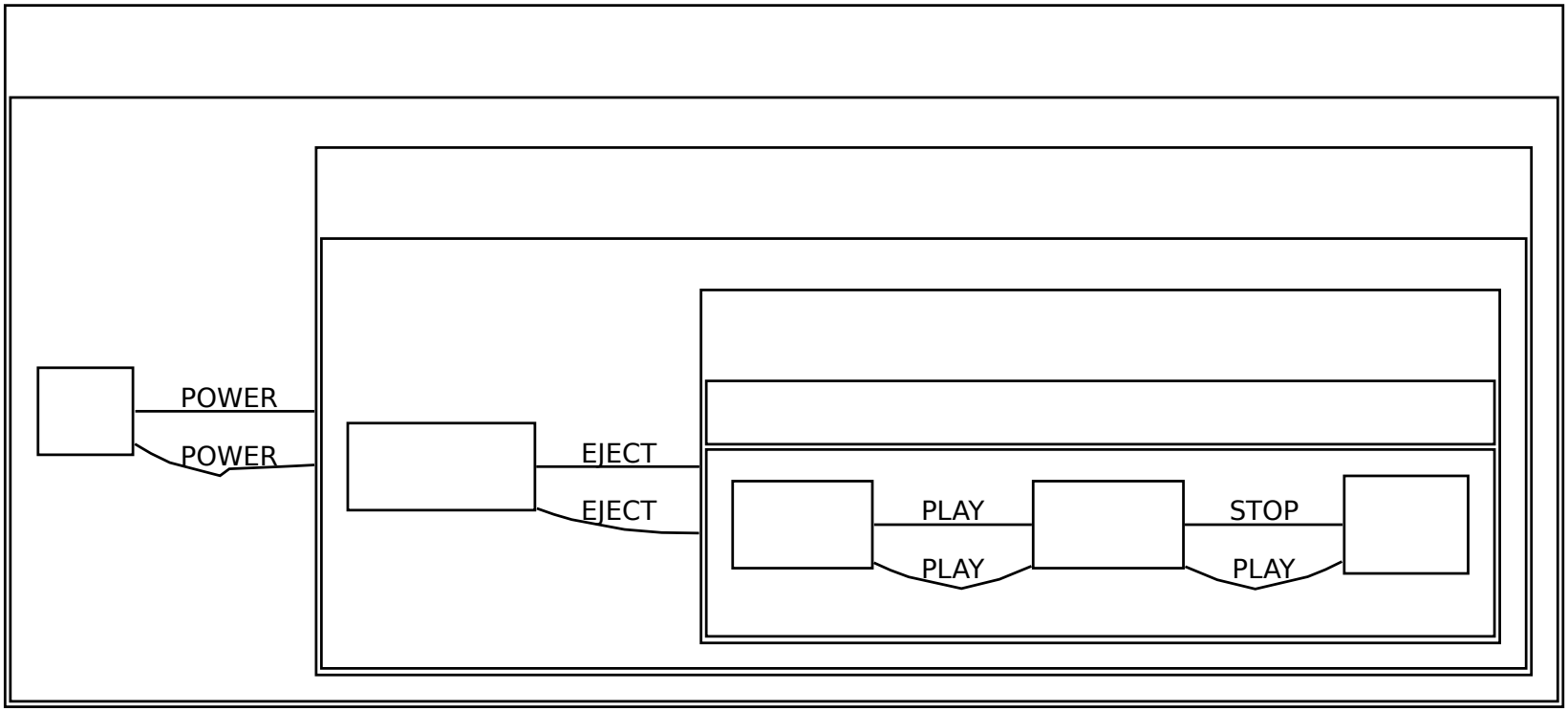

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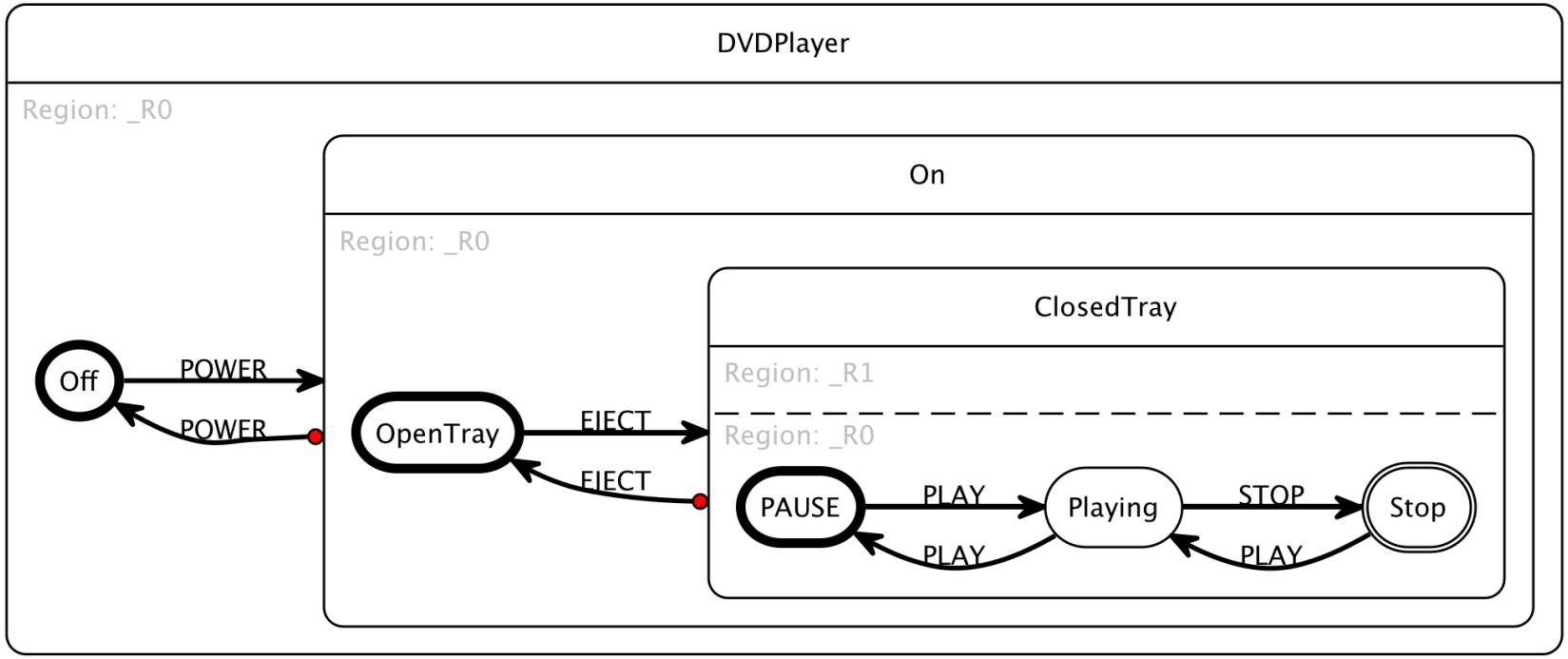

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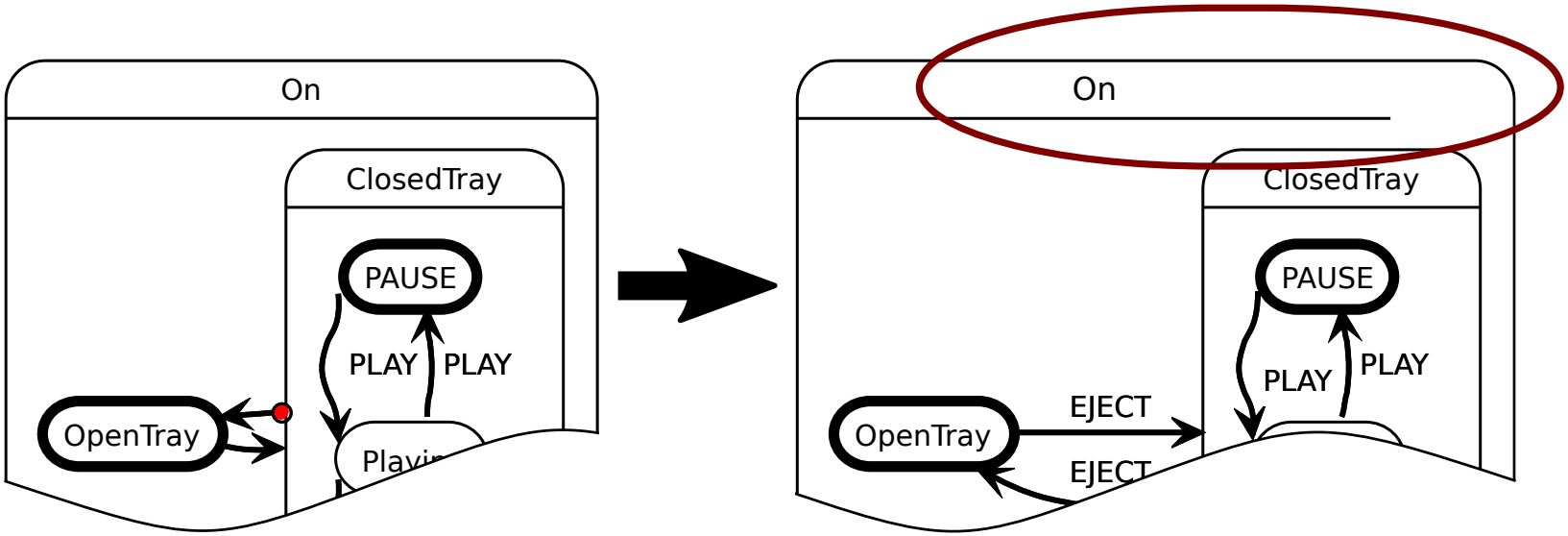

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```
KNode {
 width=200 height=200
 KRoundedRectangle cornerWidth=10, cornerHeight=10 {
  KText "On" {
   KAreaPlacementData
    topLeft TOP abs=0px rel=0, LEFT abs=10px rel=0
    bottomRight TOP abs=20px rel=0, RIGHT abs=10px rel=0
  }
  KPolyline {
   points =
    (TOP abs=20px rel=0, LEFT abs=0px rel=0),
    (TOP abs=20px rel=0, RIGHT abs=0px rel=0)
  }
  ...
```

Architecture overview

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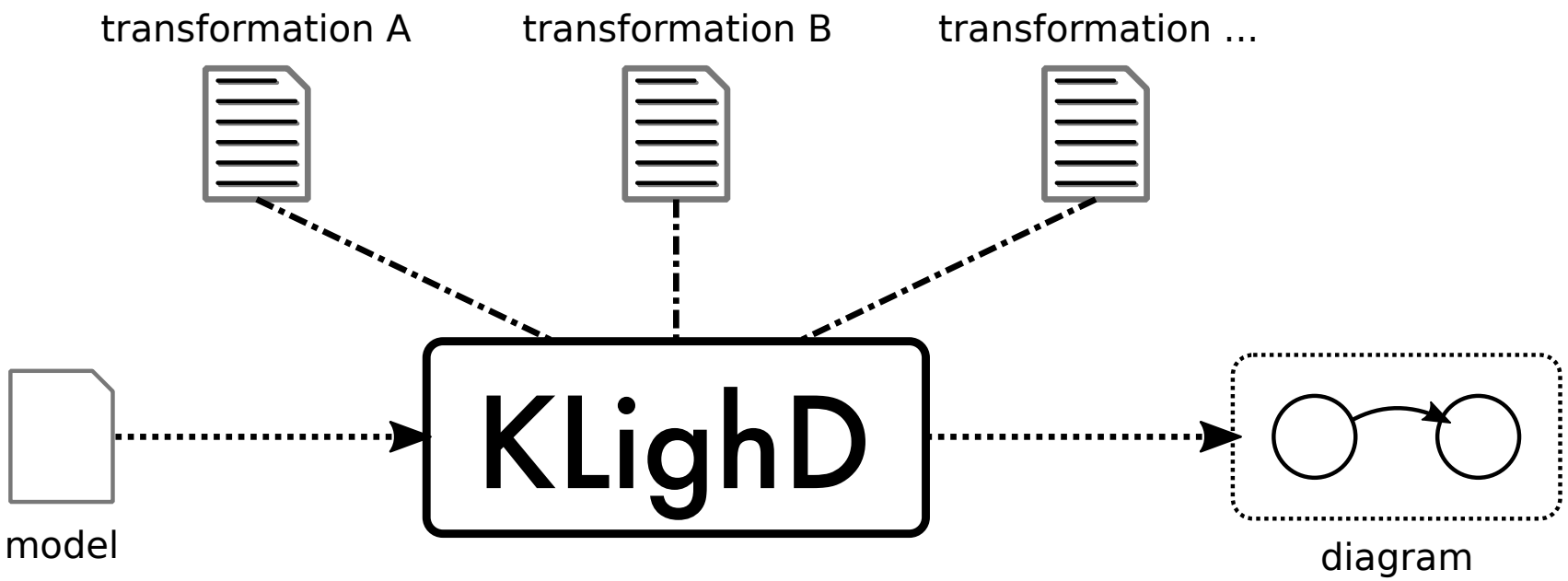

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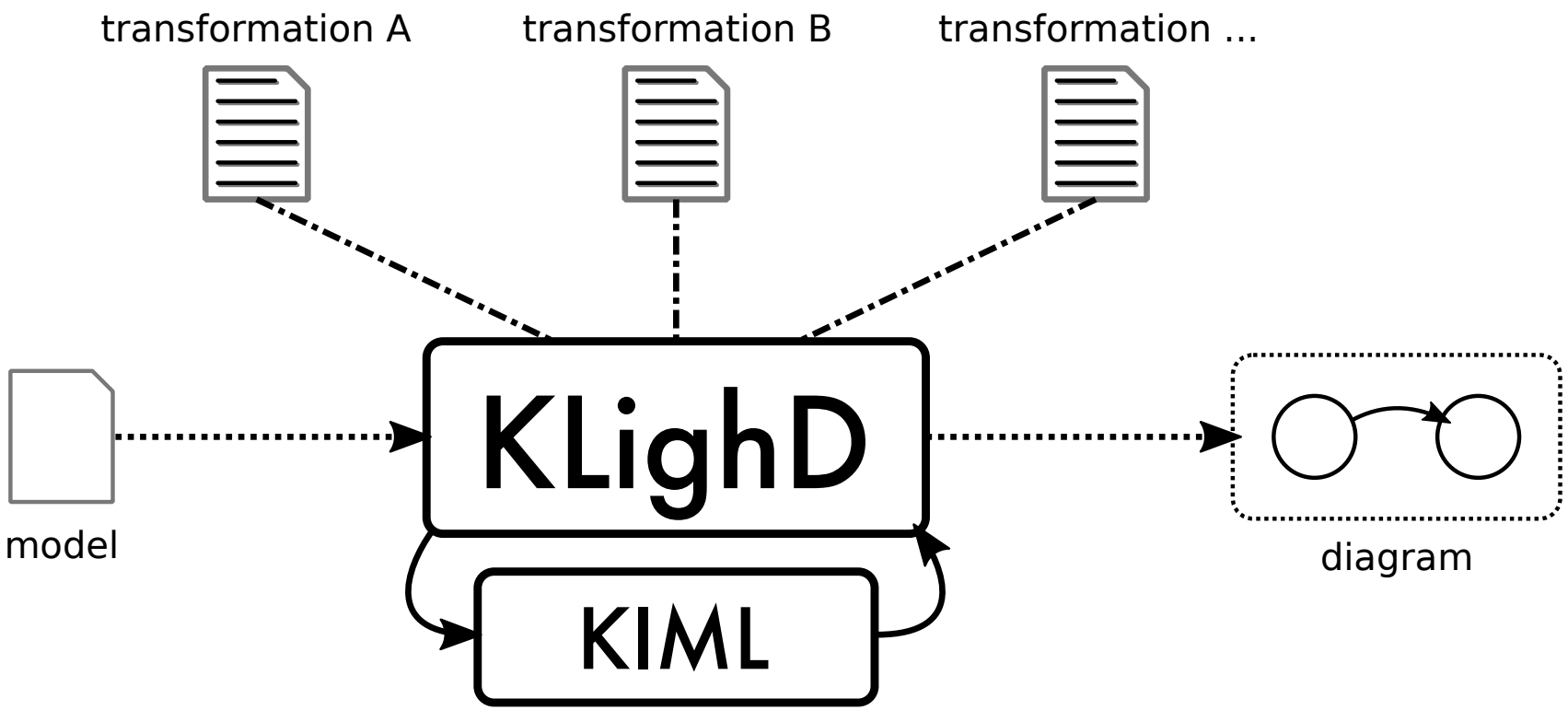

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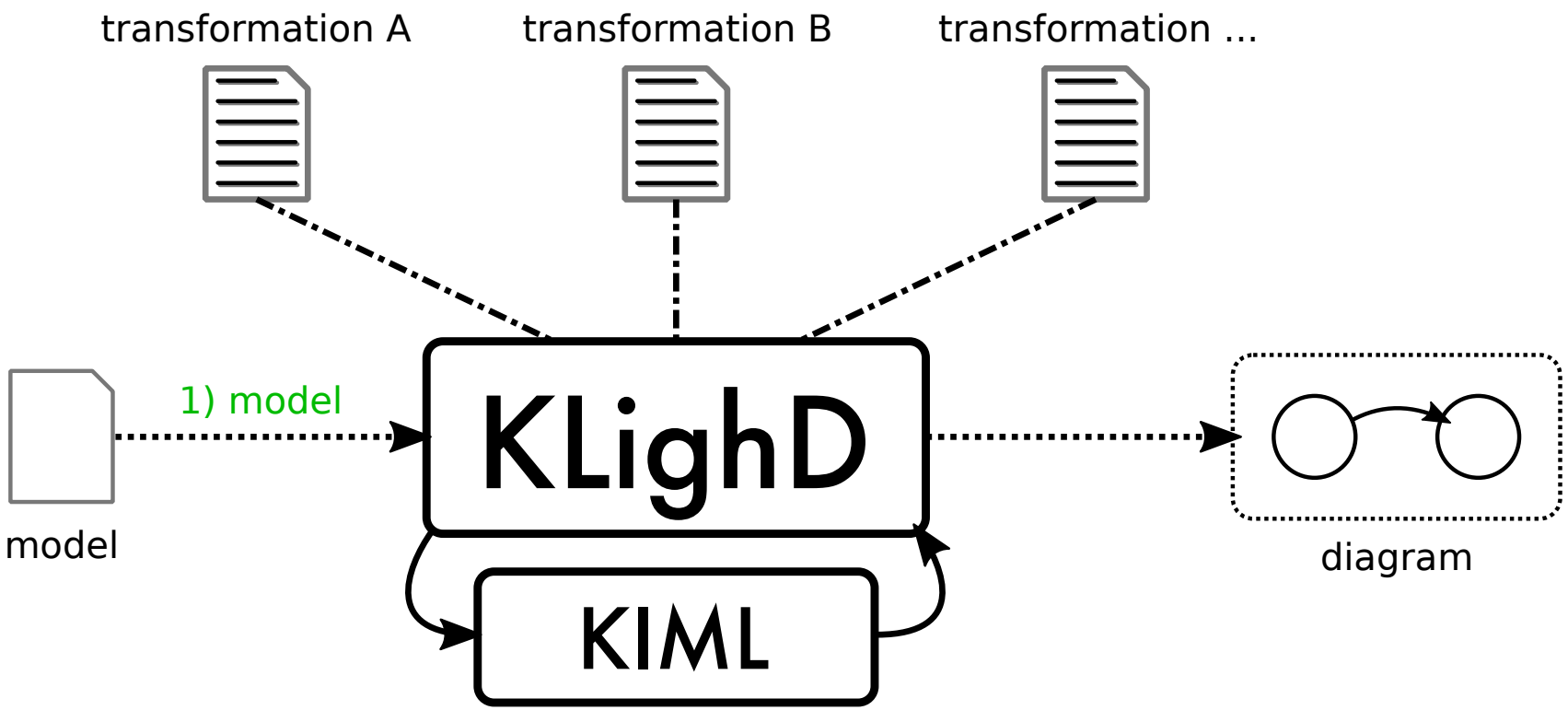

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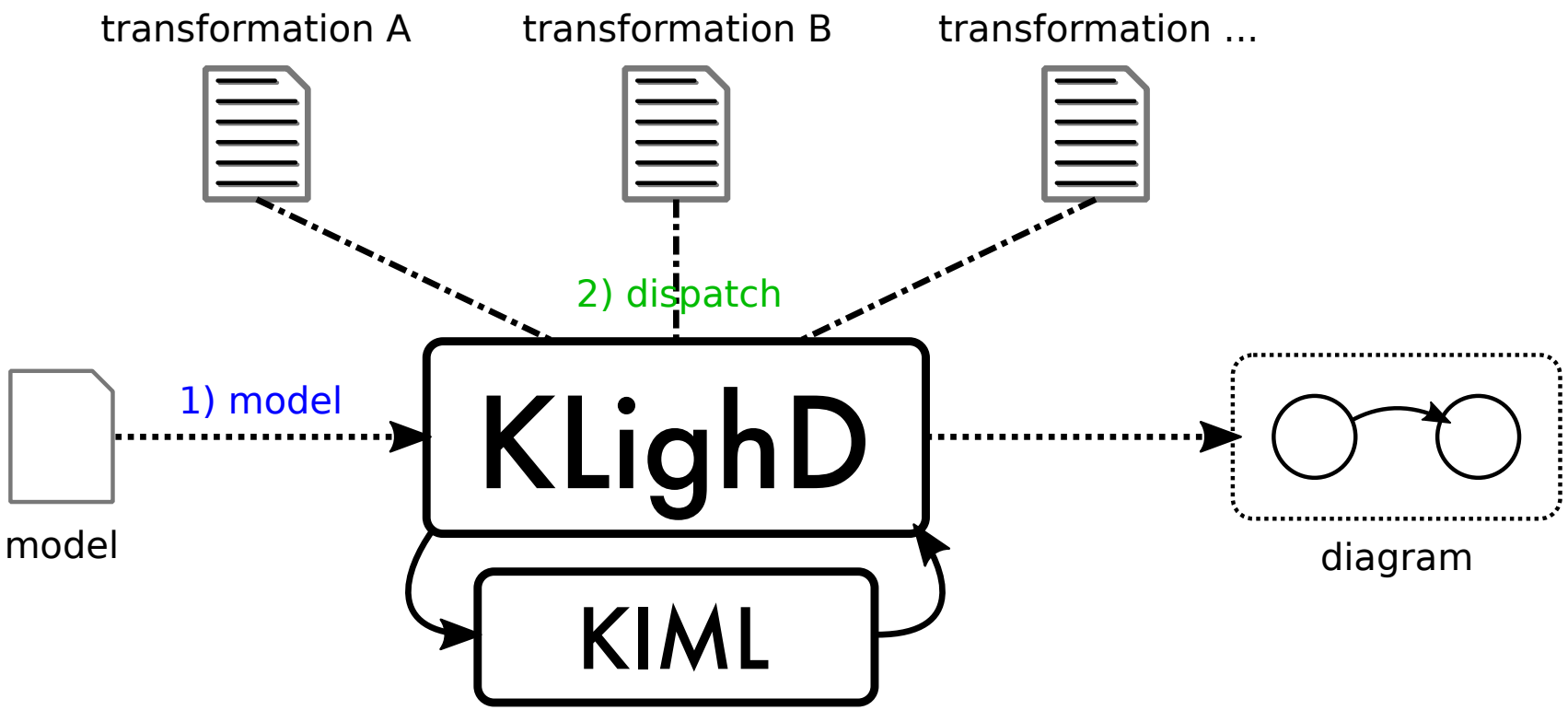

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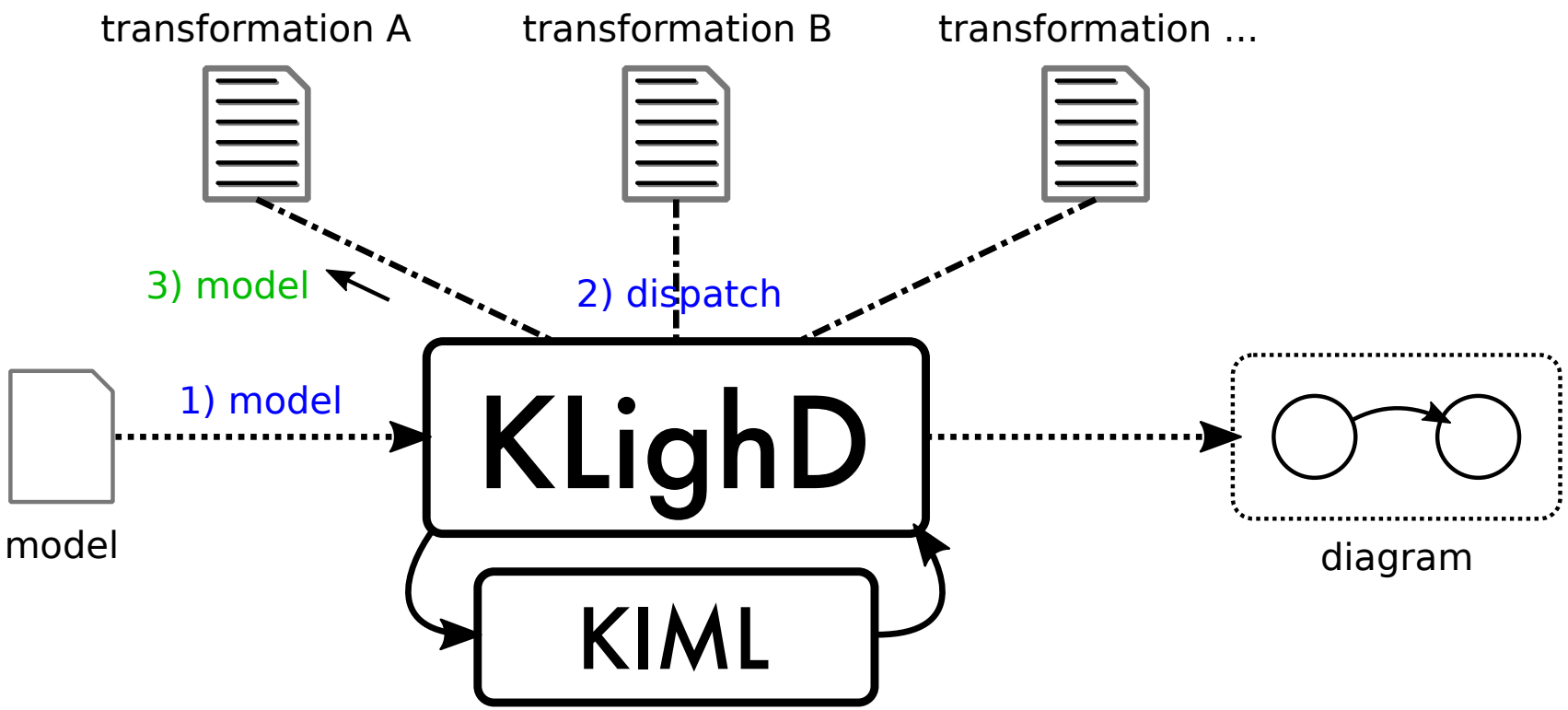
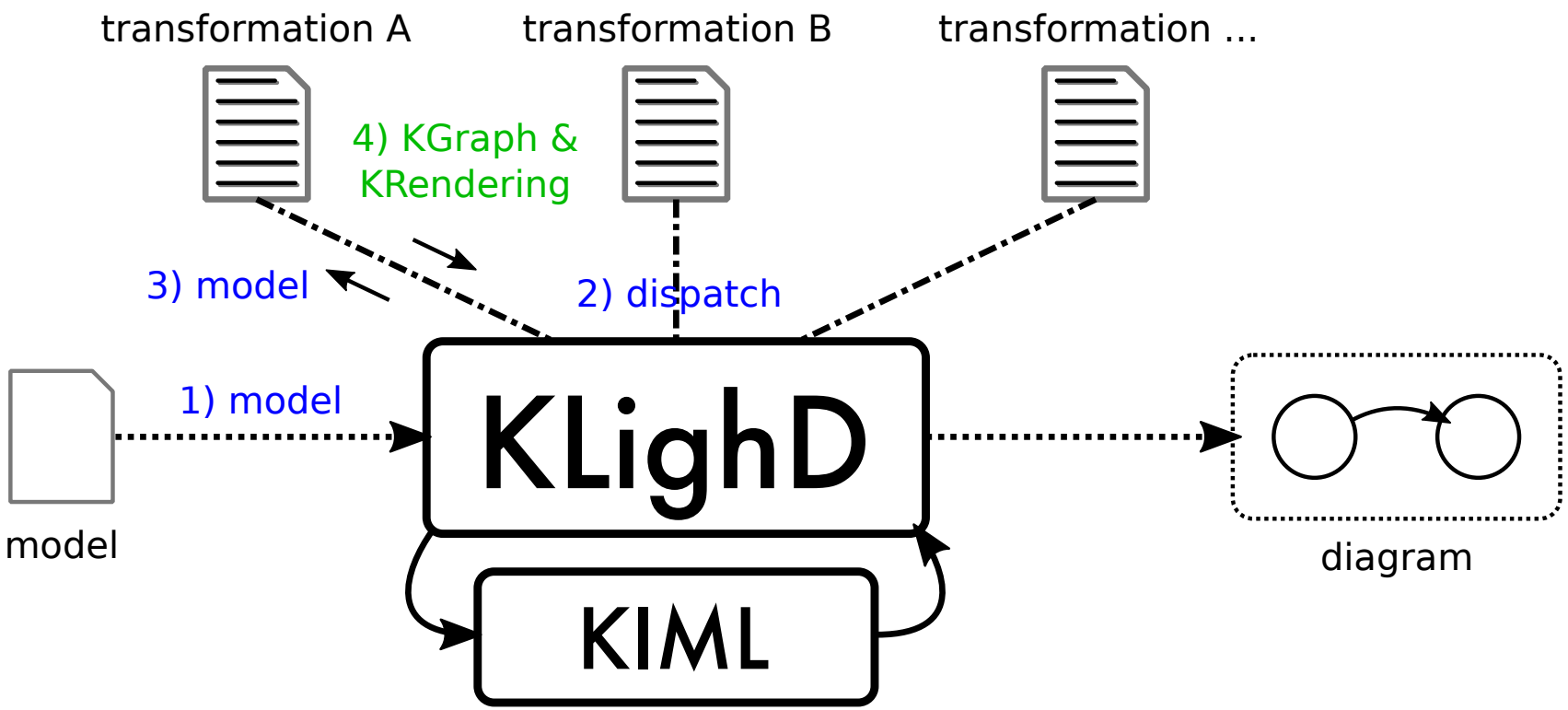


Architecture overview



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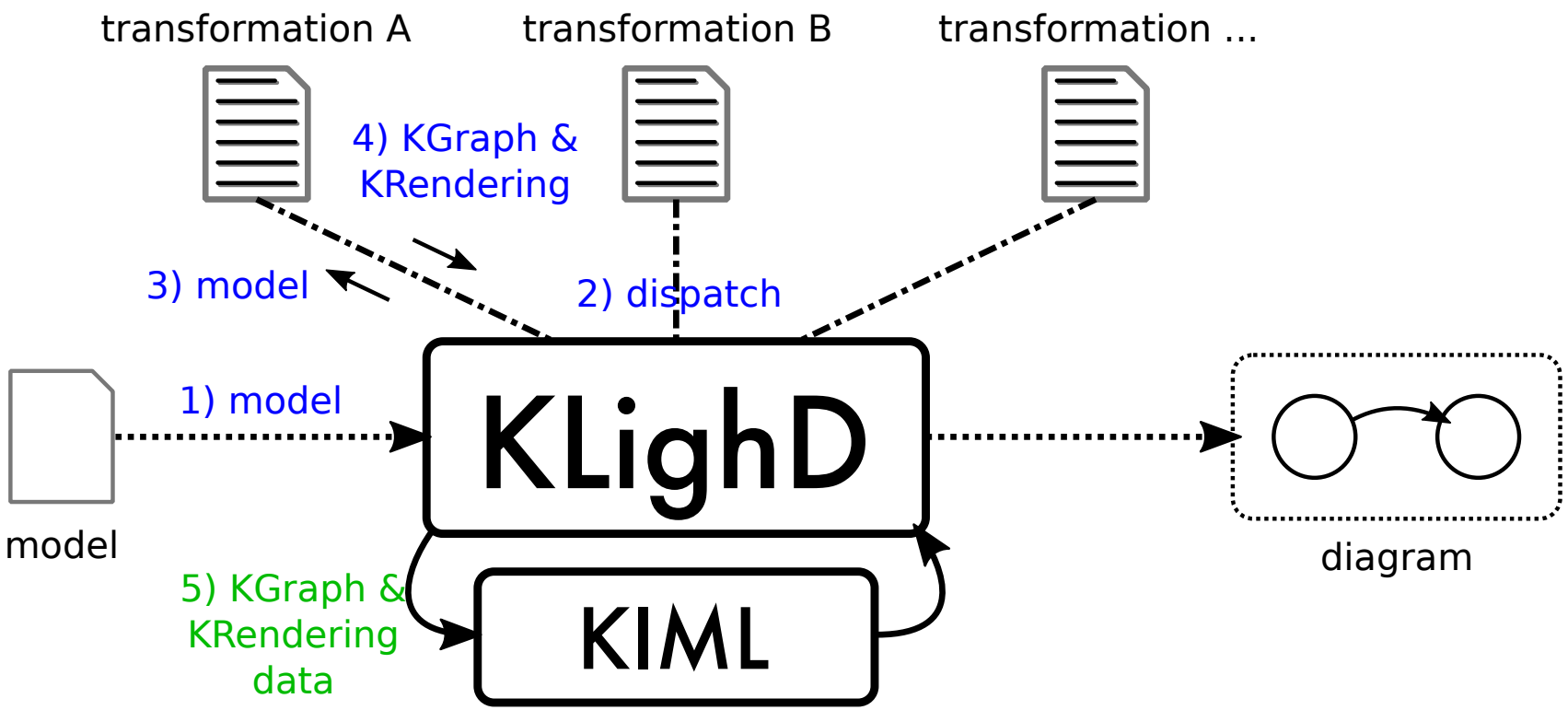
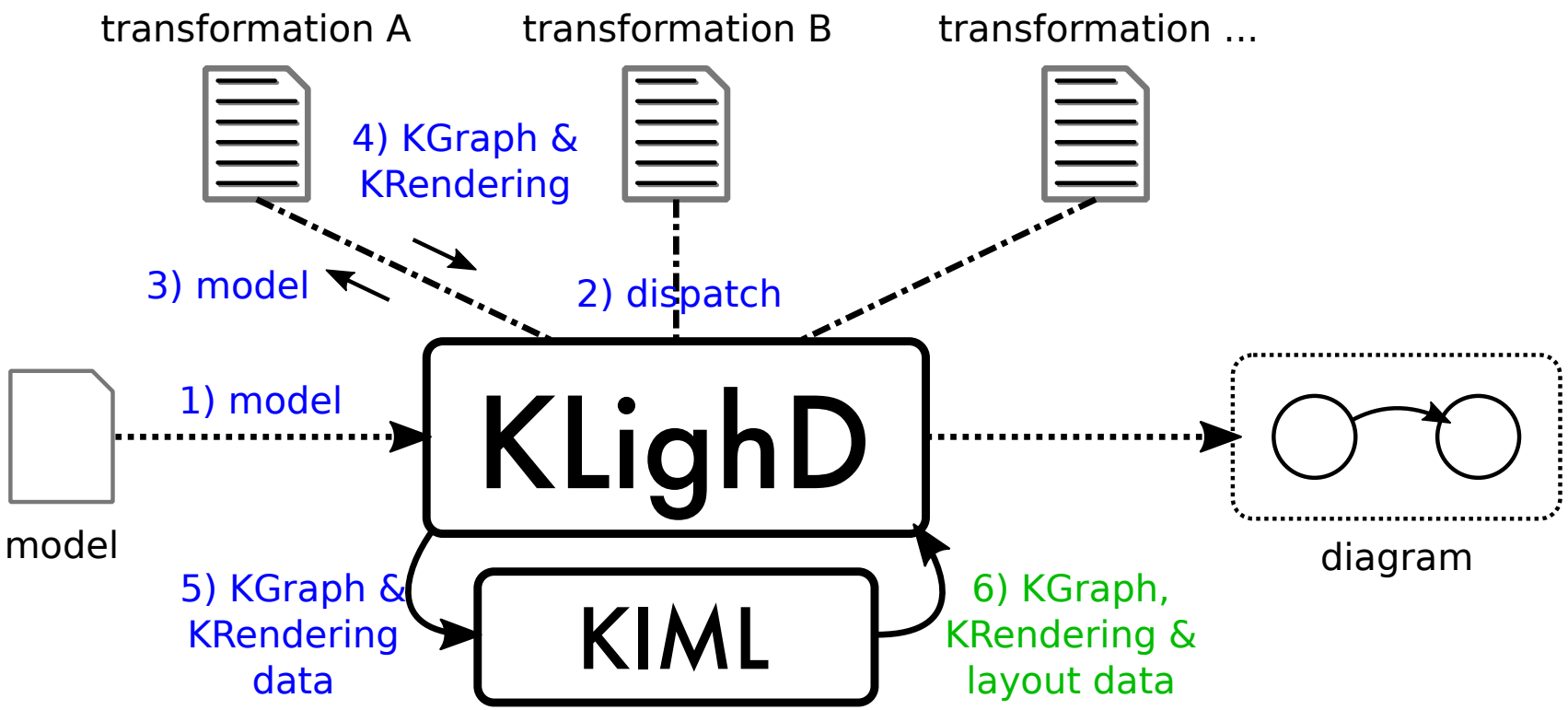


Architecture overview



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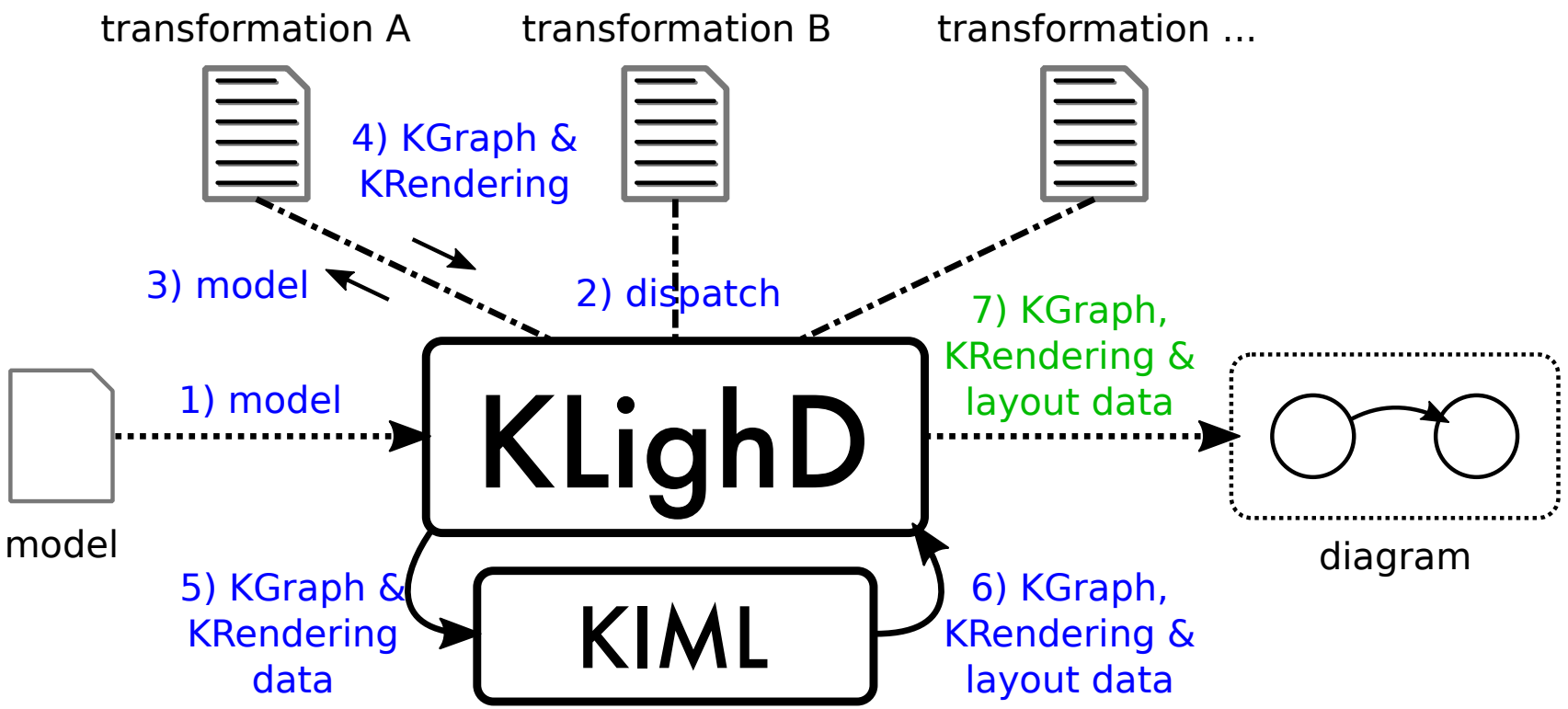

KGraph/KRendering Diagram Notation Format

- Designed for describing concrete diagrams
  - Formulated in EMF's meta modeling language *Ecore*
  - Lifts diagram synthesis to modeling level of abstraction

KGraph/KRendering Diagram Notation Format

- Designed for describing concrete diagrams
  - Formulated in EMF's meta modeling language *Ecore*
  - Lifts diagram synthesis to modeling level of abstraction
- Clear separation of diagram structure (KGraph, coordinates) and appearance (KRendering)
- Enables declarative micro layout statements
- Aims at reducing concrete-coordinate-related statements as much as possible

Schneider, Spönemann, von Hanxleden
Just Model! – Putting Automatic Synthesis of Node-Link-Diagrams into Practice
VL/HCC'13

Outline

Wrap-Up

The Problem

- Lots of productivity wasted with drawing diagrams manually
- Sign for trouble: the palette

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The Problem

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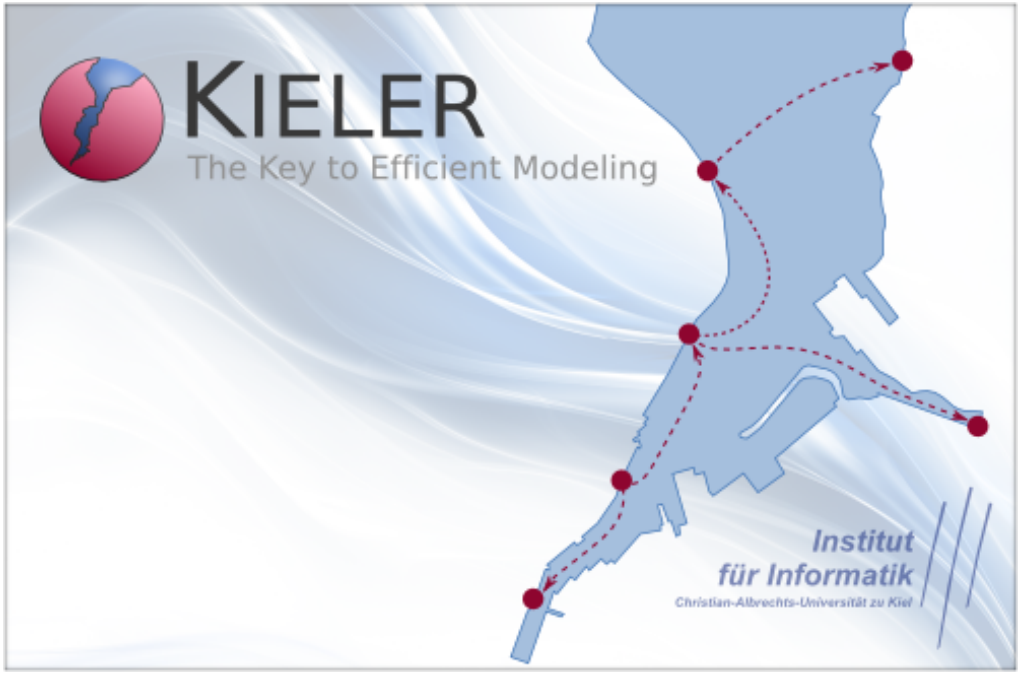
Our Approach

- Pragmatics-aware modeling
- Let designer concentrate on *model*, automatically synthesize *views*
- Employ *filtering* to synthesize views customized to user stories
- Key enabler: automatic layout

Outlook

- DSL for synthesis of transient views
- Smart layout configuration
- Collaborative web-based model browsing
- Efficient browsing of very complex models (think google maps)

Get In Touch



- Open-source license (EPL) encourages commercial use
- `http://www.informatik.uni-kiel.de/rtsys/kieler/`

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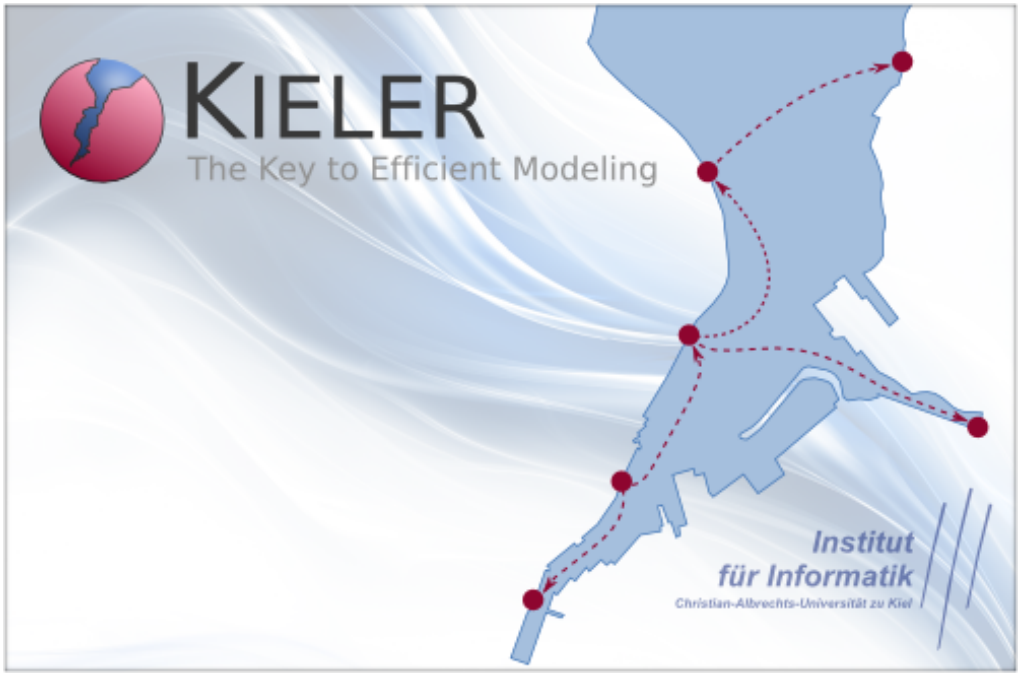

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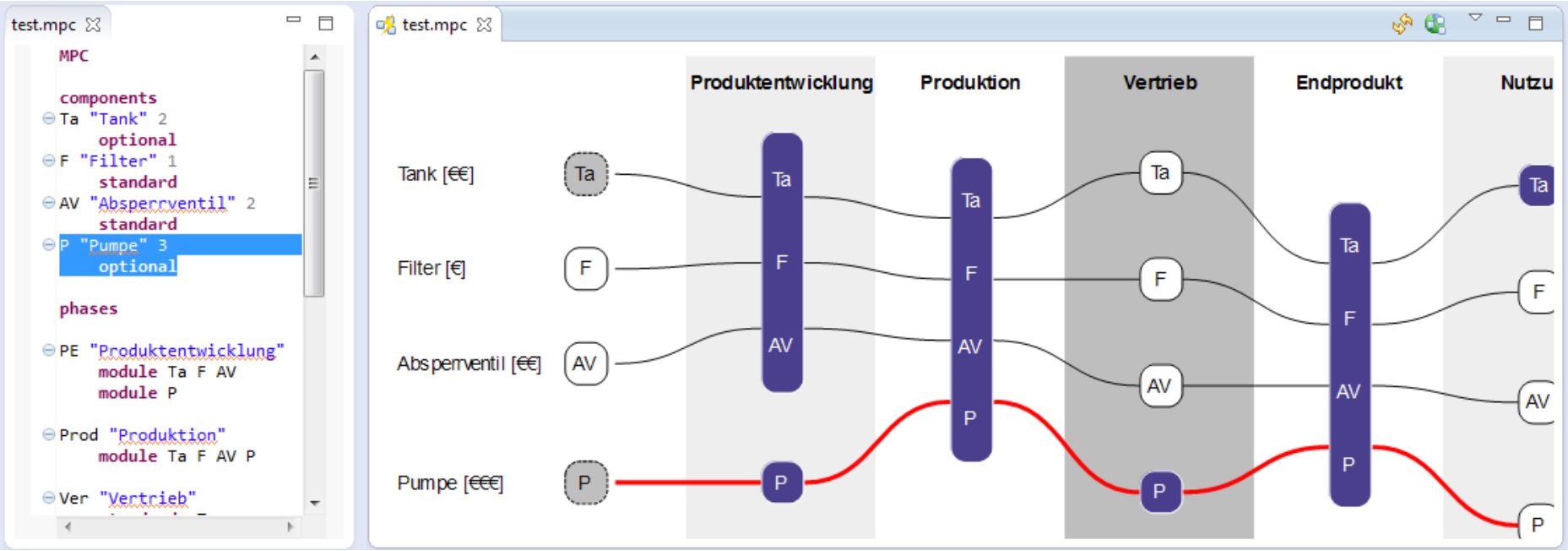
thanks!

questions or comments?

Appendix

Further examples

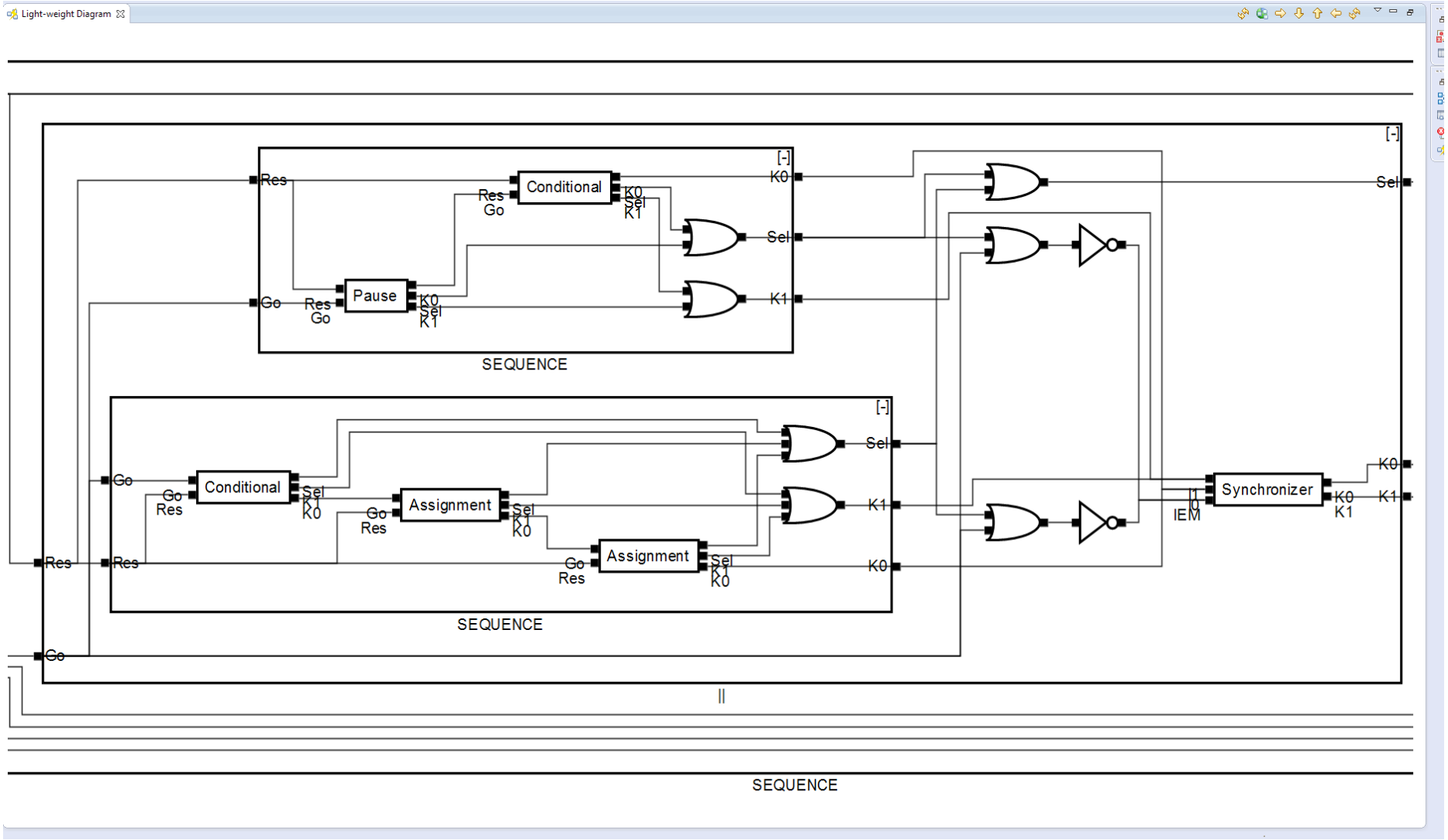
Component clustering



Christoph Blees
Eine Methode zur Entwicklung modularer Produktfamilien
Dissertation, TU Hamburg-Harburg Schriftenreihe Produktentwicklung und Konstruktionstechnik vol. 3, 2011

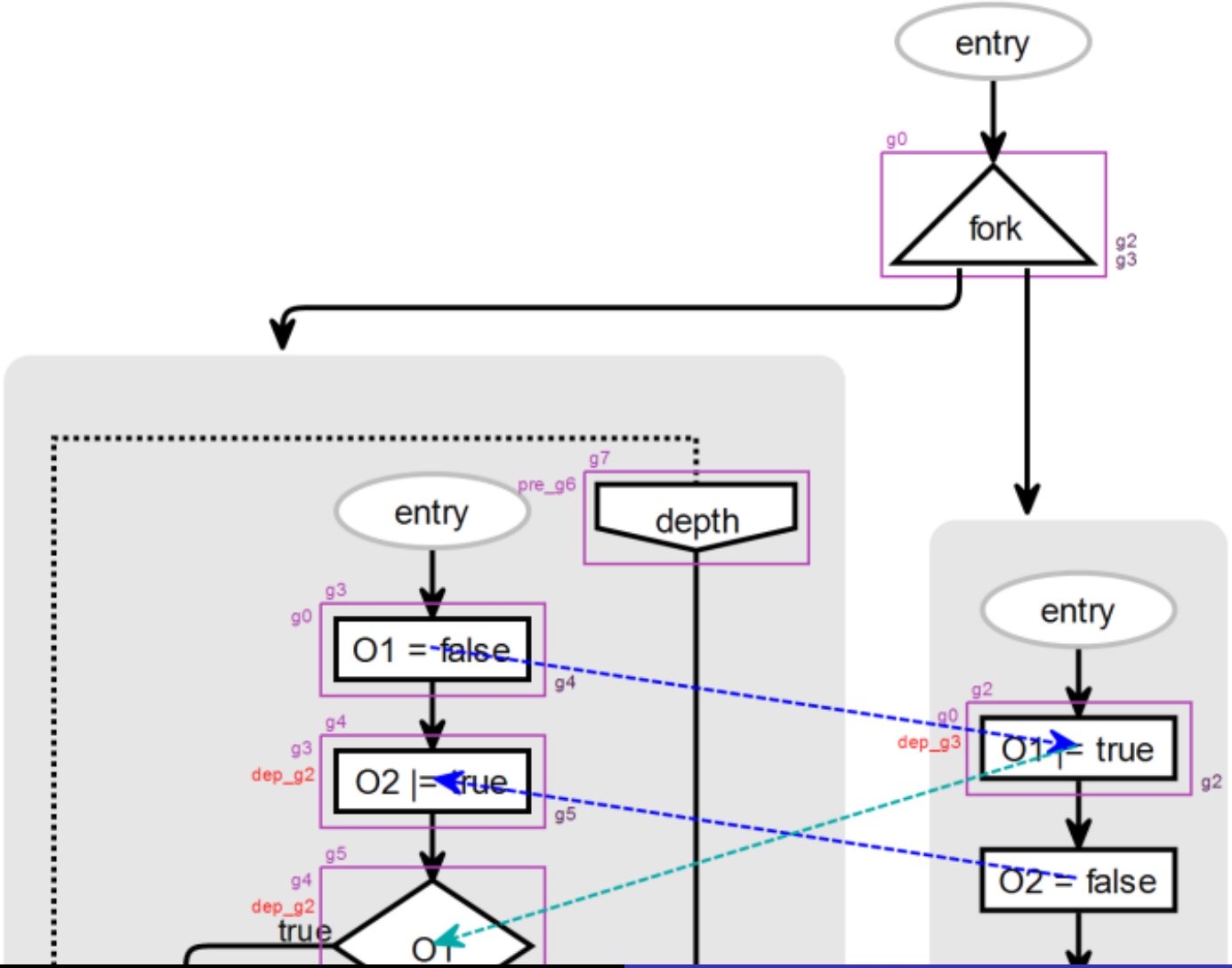
Further examples

Net lists



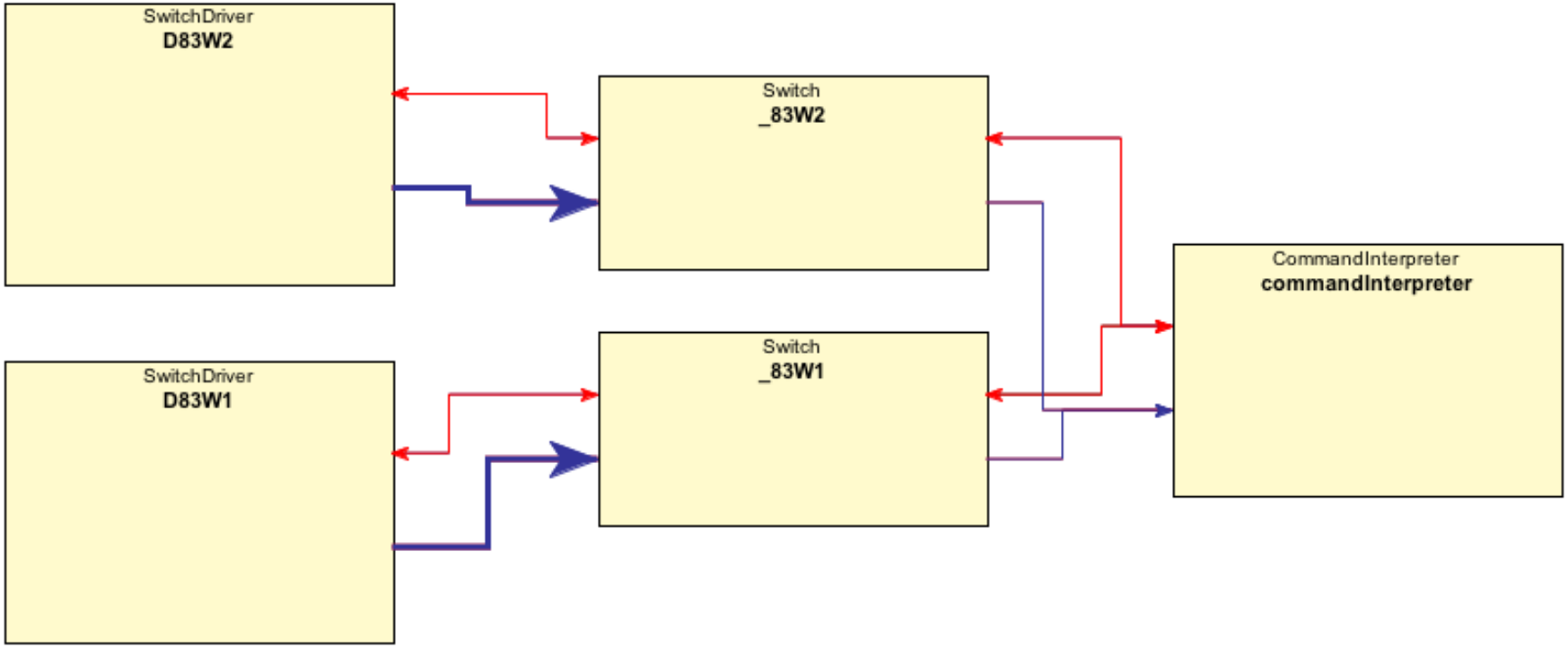
Further examples

Control flow graph



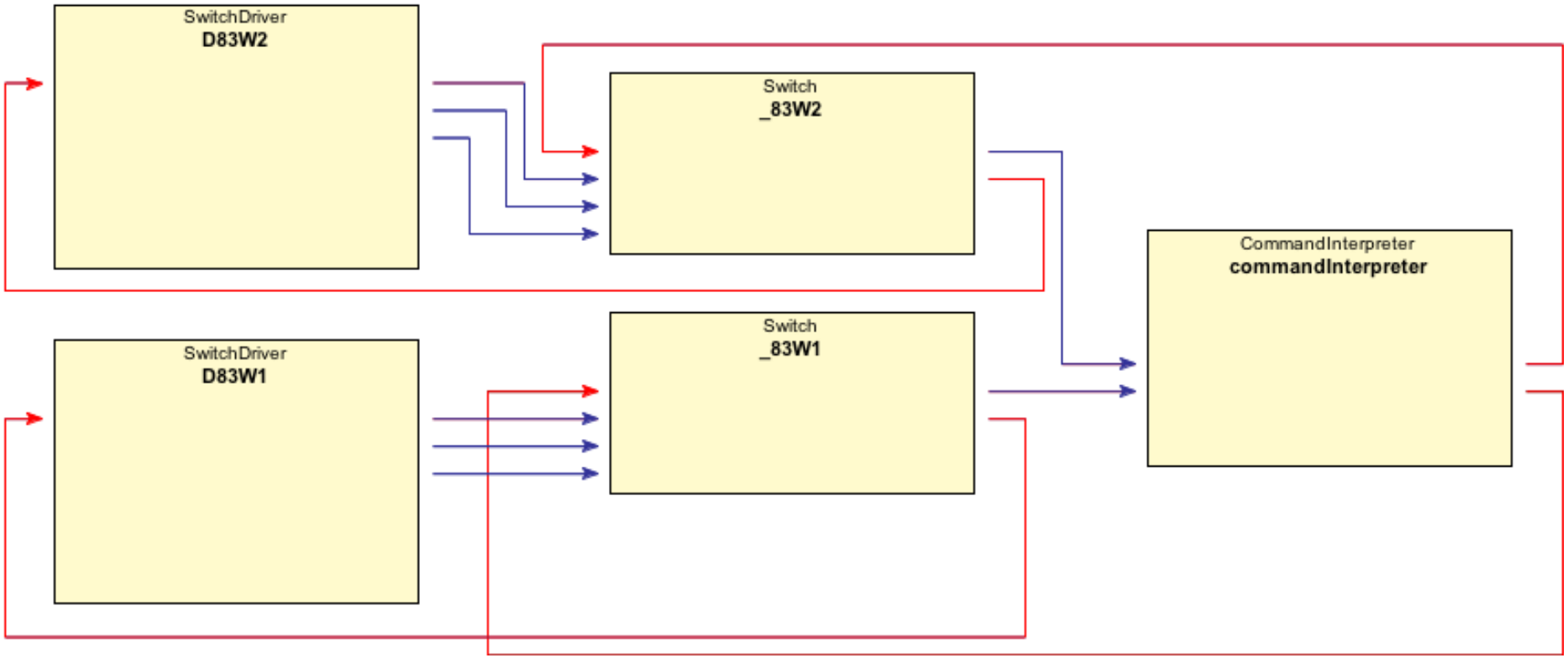
Further examples

Domain-specific components



Further examples

Domain-specific components



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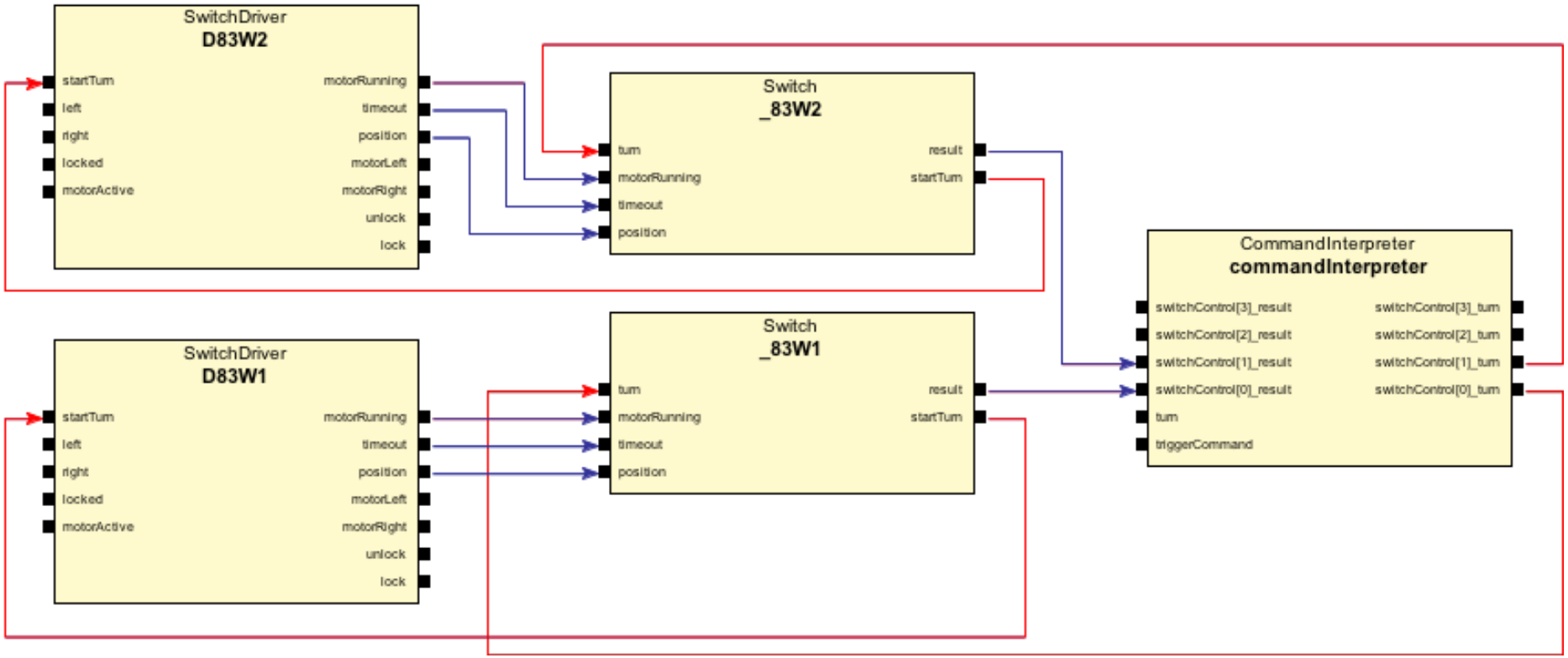

Related Work

Robert Ian Bull
Towards A Model Driven Engineering Approach For Information Visualization
Ph.D. thesis, University of Victoria, BC, Canada (2008)

Jan Koehnlein
Discovery Diagrams for the Generic Graphical View
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Martin Auer, T. Tschurtschenthaler, and Stefan Biffl,
A Flyweight UML Modelling Tool for Software Development in Heterogeneous Environments
29th EUROMICRO Conference "New Waves in System Architecture" (2003)
http://www.umlet.com

OMG Diagram Definition (DD), 2012)
http://www.omg.org/spec/DD/1.0/

More Related Work

Akos Ledeczi et al.
The Generic Modeling Environment
IEEE Workshop on Intelligent Signal Processing (WISP 2001)

Gergely Mezei et al.
Visual presentation solutions for domain specific languages
IASTED International Conference on Software Engineering (2006)

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3rd International Workshop on Graph Based Tools (GraBaTs'06)

Eclipse GMF (http://www.eclipse.org/modeling/gmp/)

Graphiti project (http://www.eclipse.org/graphiti/)

Benjamin B. Bederson et al.
Toolkit Design for Interactive Structured Graphics
IEEE Transactions on Software Engineering, Vol. 30, No. 8 (2004)