

Developing an Interactive, Visual Monitoring Software for the Peer Model Approach

Masterstudium:
Visual Computing

Maximilian Alexander Czuk

Technische Universität Wien
Institut für Computersprachen
Programmiersprachen und Übersetzer
Betreuerin: A.o. Univ. Prof. Dr. Dipl.-Ing. eva Kühn

Introduction and Motivation

- ▶ The **Peer Model** is a programming model for **distributed systems** [KCJ⁺13]
- ▶ Distributed systems are **hard to debug and monitor**
- ▶ **No tools for debugging or monitoring** a peer model exist
- ▶ A **visual monitoring software** can help developers find bugs and inconsistencies, as well as aid in becoming acquainted with previously unfamiliar systems
- ▶ Realisation of a **post-mortem debugging approach**

Goals and Challenges

- ▶ Investigate what peer model developers are missing to **formulate requirements**
- ▶ **Define the necessary data** for proper monitoring of peer models
- ▶ **Develop visual representations** to present the gathered data in a meaningful way while **keeping the established visual notation intact**
- ▶ Employ **visualisation and interaction mechanics** for exploring peer models and their processes
- ▶ **Automatic generation** of peer model layouts
- ▶ **Implementation** of the monitoring software

Methods

Interviews

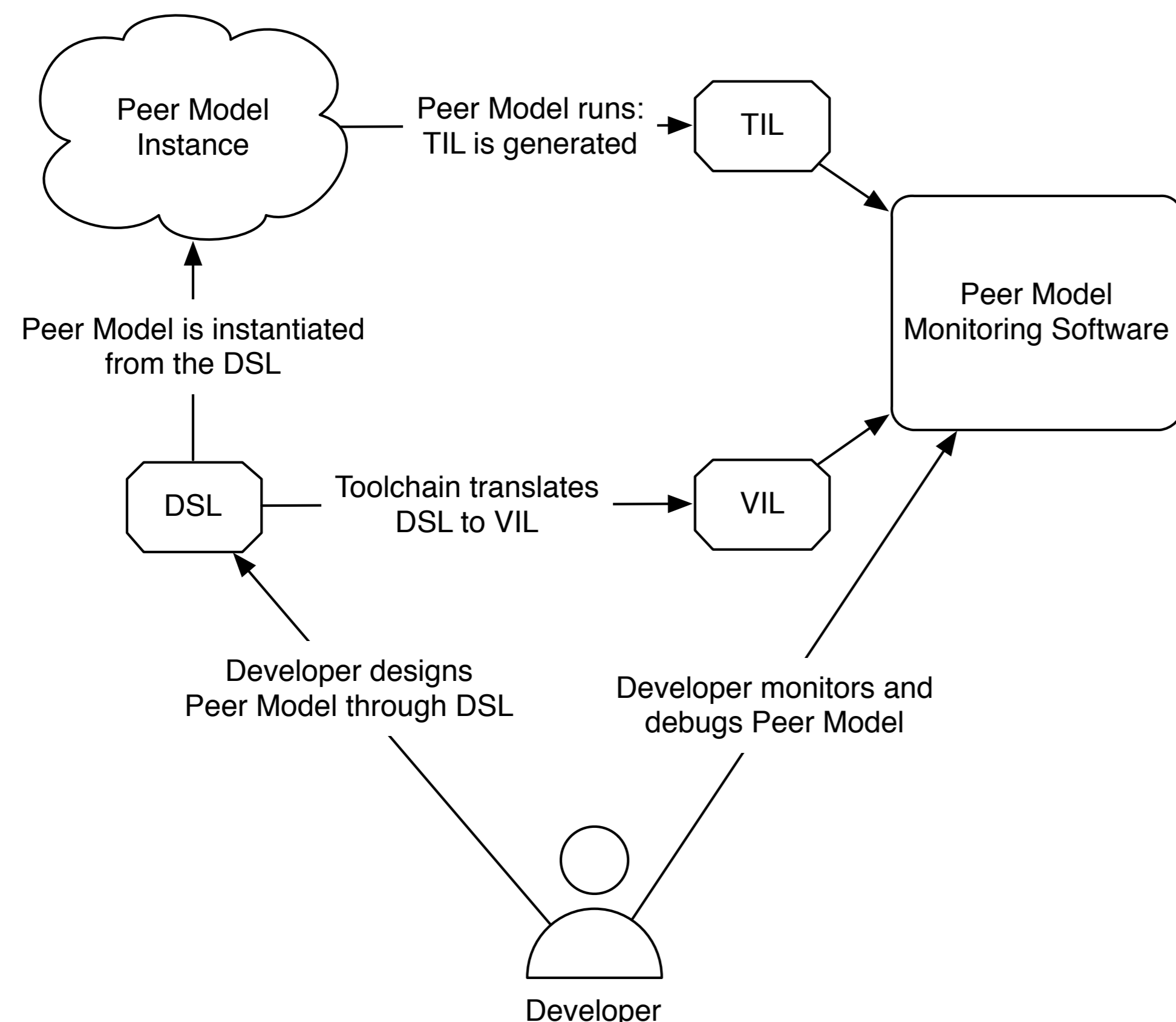
- ▶ **Personal interviews** with peer model developers
- ▶ Basis for **requirement analysis**

File Format Development

- ▶ **Static peer model structure** from the Peer Model DSL (**VIL**)
- ▶ **Dynamic events (trace)** occurring in a running peer model (**TIL**)

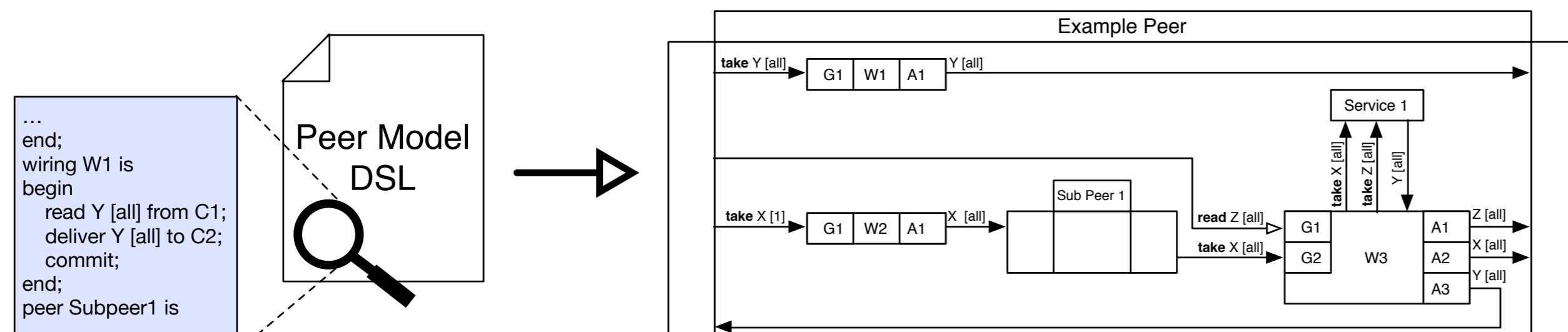
Peer Model Representation

- ▶ Transformation of the textual peer model definition into a graphical representation
- ▶ **Overlay of dynamic events** from the trace onto the static peer model notation
- ▶ **Overview and Detail**: display a moment in time in detail while giving an overview in the time dimension [CKB09]
- ▶ Use of **colour and metaphors** to improve comprehensibility



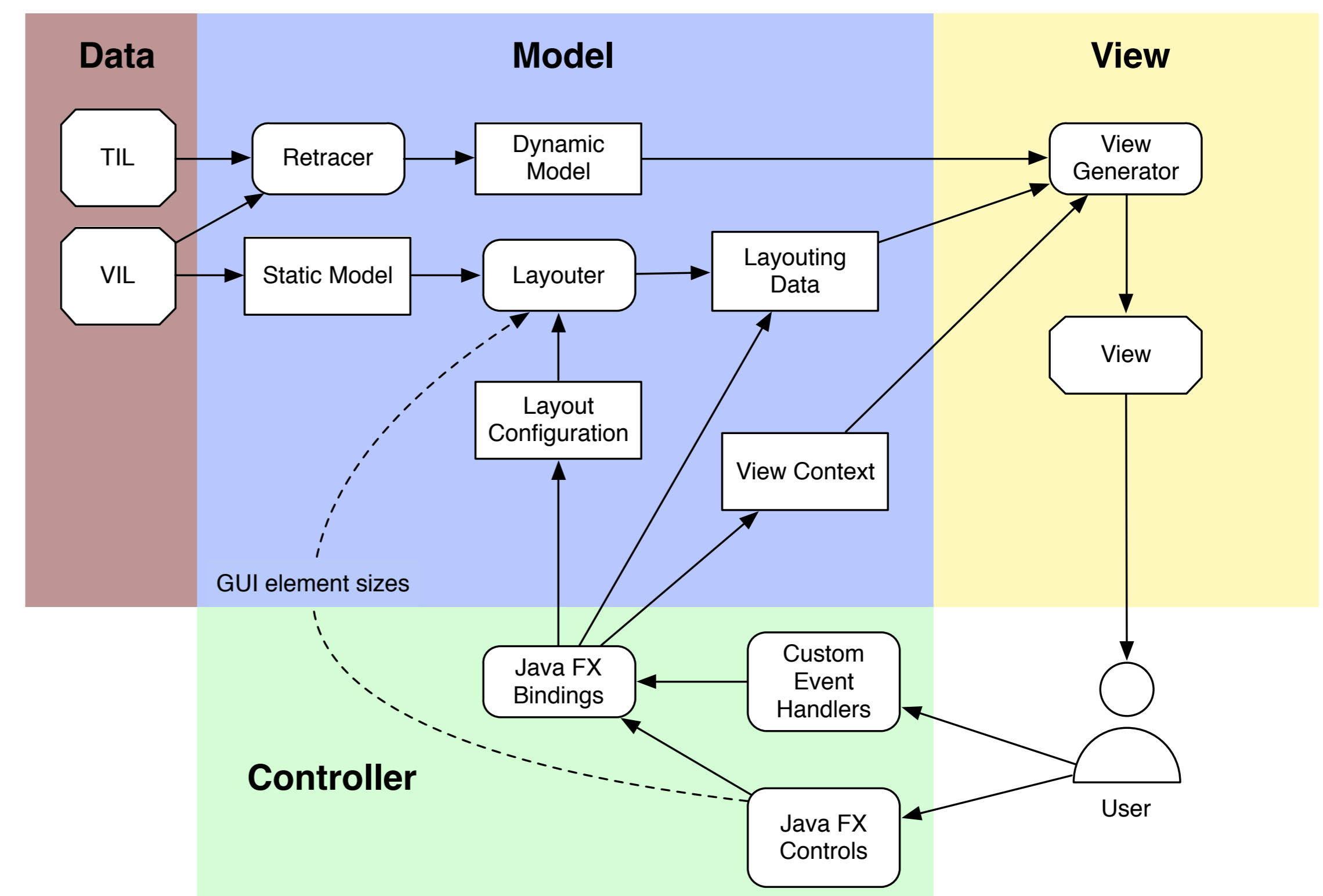
Layouting Framework

- ▶ Peer model DSL contains **no information on how to visualise it**
- ▶ To display the model, **automatic layouting** is required
- ▶ **Visual notation is similar to a graph**, but more sophisticated
- ▶ Process resembles **printed circuit board layouting**
- ▶ Layouting framework utilises the **Sugiyama algorithm** [STT81], **pathfinding** and a **novel layout packing approach**



Implementation

- ▶ **Graphical UI library**: JavaFX ¹
- ▶ Custom **layouting framework implementation**
- ▶ **Model-View-Controller** software architecture

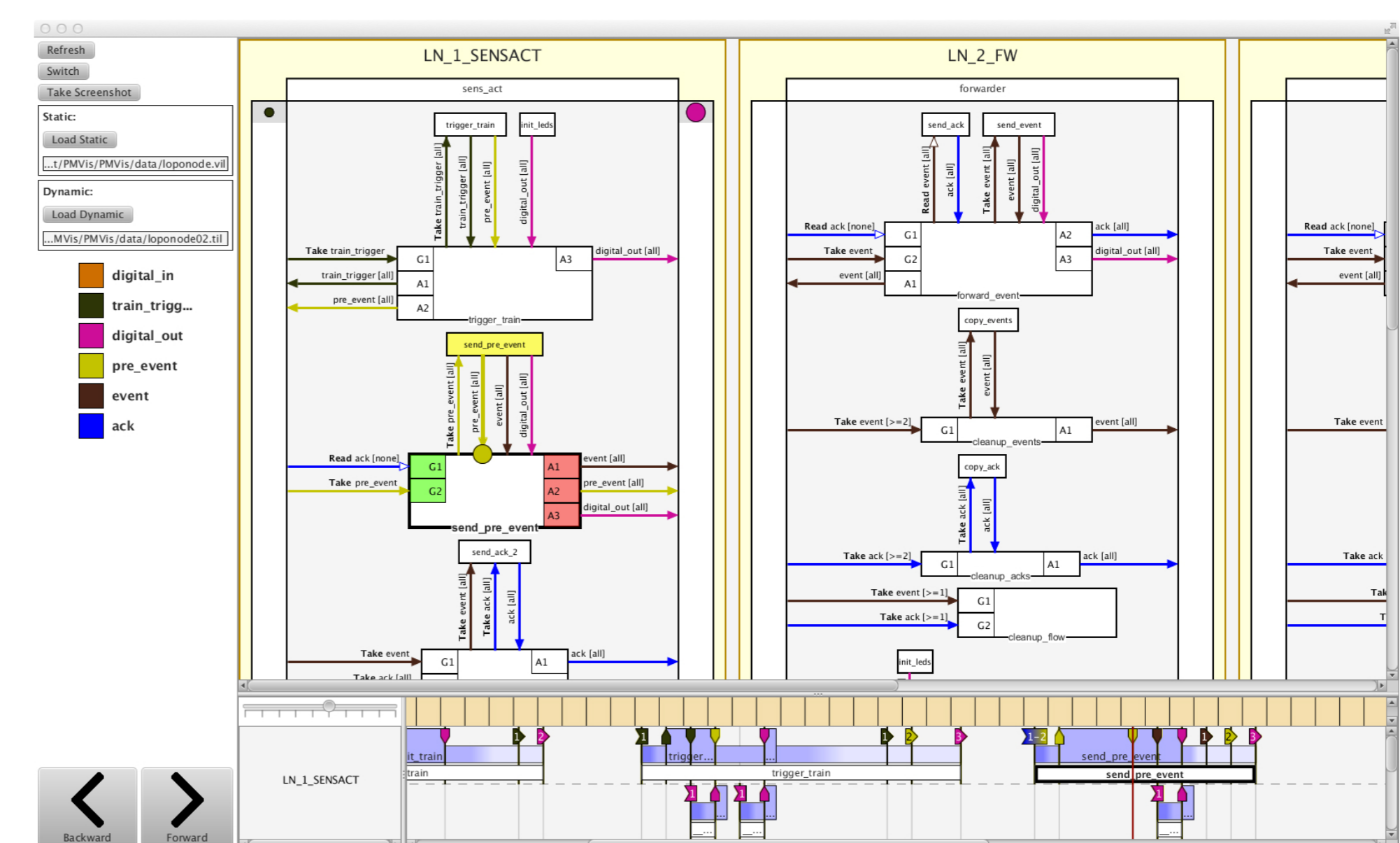


Evaluation - Comparison With Similar Tools

	Peer Model Monitoring Tool	Reo ECT	Petri Nets CPN Tools	UPPAAL UPPAAL	WS-BPEL EA4B	BPMN VP
Static Notation	✓	✓	✓	✓	✓	✓
Dynamic Notation	✓	✓	✓	✓	✓	✓
Time Control	✓	✗	✗	✓	✗	✗
Temporal Overview	✓	✗	✗	✓	✗	✓
Tracing Format	✓	✗	✗	✓	✓	✗
Automatic Layouting	✓	✗	✗	✗	✓	✓
Layout Customisation	✓	✓	✓	✓	✗	✓
Information Hiding	✓	✓	✓	✗	✓	✓

Results

- ▶ Development of a **support tool for peer model developers**
- ▶ Employment of **visualisation and interaction techniques for distributed system monitoring and debugging**



References

- ▶ Andy Cockburn, Amy Karlson, and Benjamin B. Bederson. A Review of Overview+Detail, Zooming, and Focus+Context Interfaces. *ACM Comput. Surv.*, 41(1):2:1-2:31, January 2009.
- ▶ eva Kühn, Stefan Craß, Gerson Joskowicz, Alexander Marek, and Thomas Scheller. Peer-Based Programming Model for Coordination Patterns. In Rocco De Nicola and Christine Julien, editors, *15th International Conference on Coordination Models and Languages (COORDINATION)*, held as part of the 8th International Federated Conference on Distributed Computing Techniques (DisCoTec), volume 7890 of *Lecture Notes in Computer Science*, pages 121-135, Florence, Italy, June 3-5 2013. Springer.
- ▶ Kozo Sugiyama, Shojiro Tagawa, and Mitsuhiro Toda. Methods for Visual Understanding of Hierarchical System Structures. *Systems, Man and Cybernetics, IEEE Transactions on*, 11(2):109-125, Feb 1981.

¹<http://docs.oracle.com/javase/8/javase-clienttechnologies.htm>