43. Das Meta-CASE-Tool MOFLON

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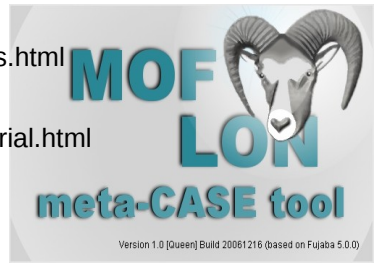
1) MOFLON Meta-CASE-Werkzeug

Reading

- MOFLON Website http://www.moflon.org
- The Eclipse-Version of the tool is called eMOFLON
  - eMOFLON tutorial
  - http://www.moflon.org/fileadmin/download/moflon-ide/eclipse-plugin/documents/release/eMoflonTutorial.pdf
- A Comparison of ATL and Story-Driven Modeling (Fujaba-style GRS)
  - http://www.es.tu-darmstadt.de/fileadmin/download/publications/spatzina/PP_AGTIVE_2011.pdf
- MOFLON Training
  - http://moflon.org/documentation/links.html
- MOFLON Tutorial
  - http://moflon.org/documentation/tutorial.html

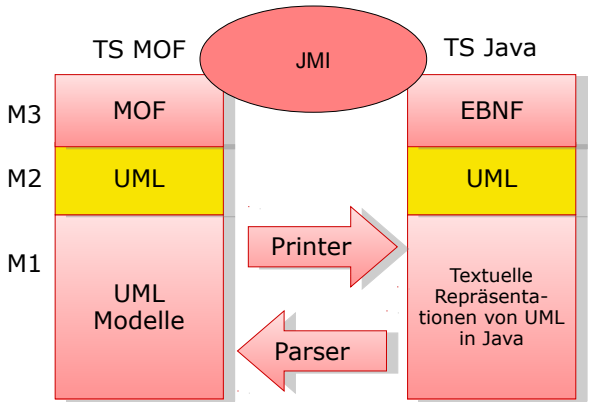


43.3.1. MOFLON Einführung

- MOFLON ist ein Metamodellierungswerkzeug der TU Darmstadt, Fachgruppe Echtzeitsysteme, Prof. Andy Schürr
  - MOFLON nutzt Logik (OCL) zum Checking von Wohlgeformtheitsbedingungen über Modellen (AC-Werkzeug)
  - MOFLON ist eine Fujaba-Erweiterung und bietet daher Graphersetzungssysteme an www.fujaba.de (M-Werkzeug)
  - MOFLON unterstützt Triple Graph Grammars (TGG, siehe ST-II)
- MOFLON unterstützt
  - MOF 2.0
  - OCL 2.0
  - JMI 1.4
  - XMI 2.1

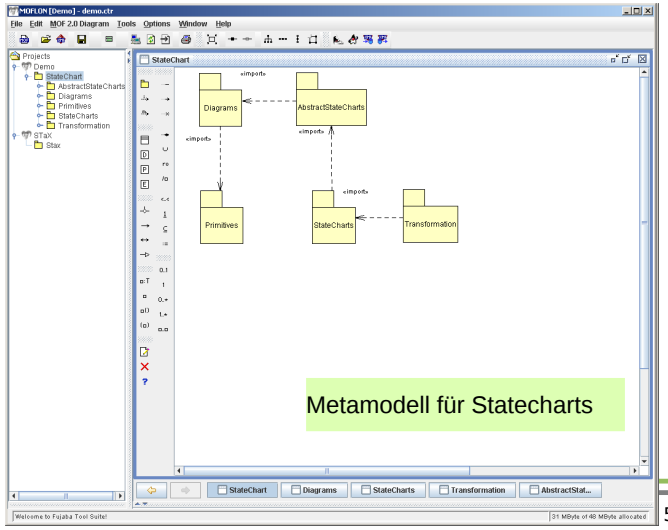
Codegenerierung mit JMI, einer transformative TS-Brücke für MOF und Java, Sprache UML

- Ähnlich zu XMI, Java Metadata Interchange (JMI) ist eine TS-Halb-Brücke für MOF und EBNF-Space, für die Sprache UML

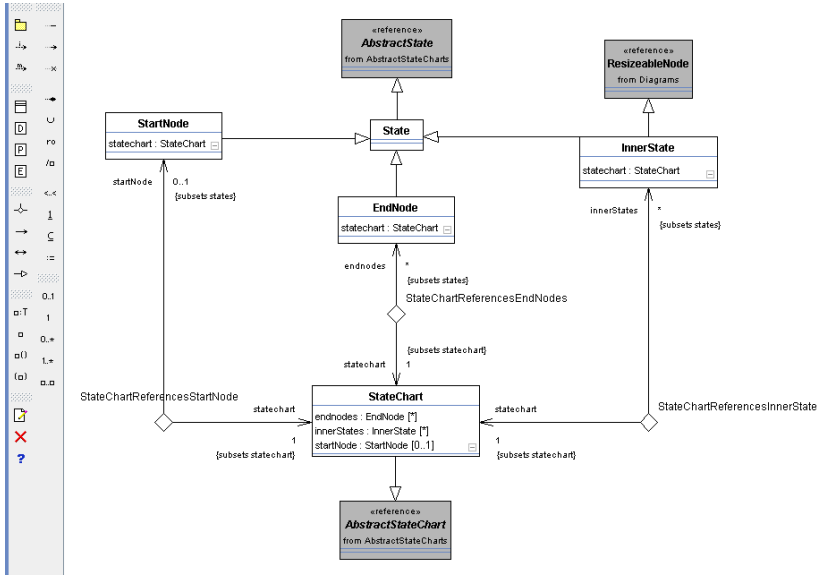


MOFLON Beispiel 1: Metamodell für Statecharts: Vorgehensweise

1) Metamodell erstellen
2) Code generieren (Repository, Constraint-checker)
3) Code über JMI-Schnittstellen verwenden

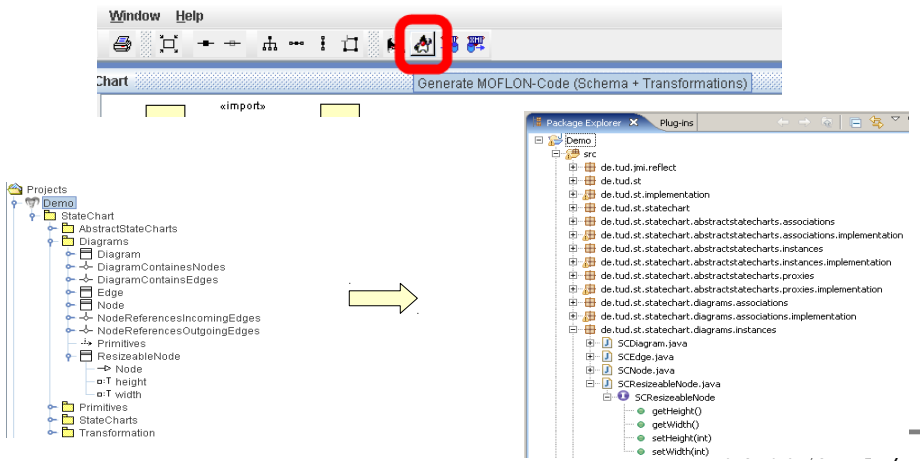


Beispiel: 1.a) Erstellung eines MOF-Metamodells für Statecharts



Beispiel: 1.b) Codegenerierung aus Metamodell für Statechart-Modelle

- Erzeugt JMI-Schnittstellen zum Metamodell (metamodellgesteuertes Repositorium)
- Generiert Code für alle als Story-Diagramm (Fujaba) modellierten Methoden
- Codegenerator verwendet Velocity und XSLT 1.1



Beispiel: 1.b) Codegenerierung aus Metamodell für Statechart-Modelle

Code generieren

Pro Package

- Java Paket
- Schnittstelle
- Implementierung

de.tud.st.statechart
SCStateChartPackage.java
SCStateChartPackageImpl.java

Pro Klasse

- Schnittstelle
- Implementierung
- Proxy Schnittstelle
- Proxy Implementierung

SCNode.java
SCNodeImpl.java
SCNodeClass.java
SCNodeClassImpl.java

Pro Assoziation

- Schnittstelle
- Implementierung

SCDiagramContainsEdges.java
SCDiagramContainsEdgesImpl.java

Beispiel: 1.c) Codeverwendung von Statechart-Modellen

- Wurzelpaket instanzieren

```
SCStateChartPackage root = new SCStateChartPackageImpl();
```

- Proxy anfordern

```
root.getSCDiagramsPackage().getSCNode();
```

- Über den Proxy Instanzen des Modells erzeugen

```
SCNode node = root.getSCDiagramsPackage().getSCNode().createSCNode();
```


43.3.2. The Metamodeling Architecture of MetaCASE Tool MOFLON

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Slides from: 10 Jahre Dresden-OCL – Workshop
http://dresden-ocl.sourceforge.net/
http://dresden-ocl.sourceforge.net/10years.html
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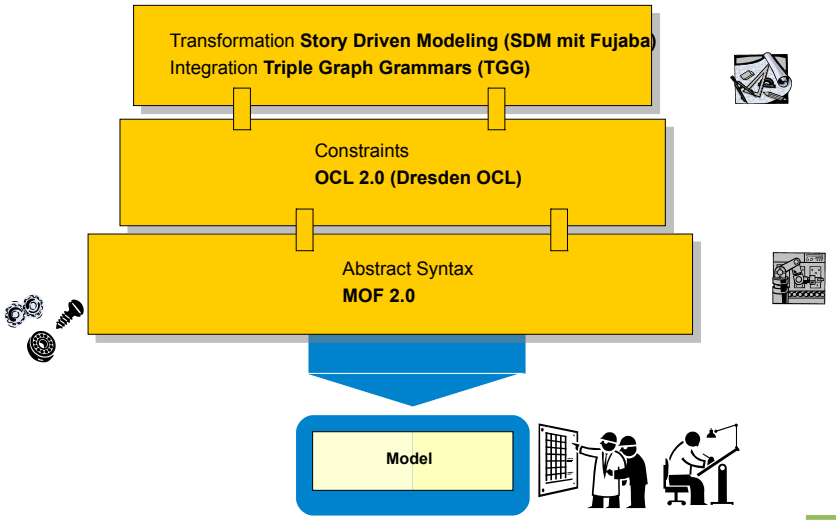
15.10.2009

Metamodel Architecture of MOFLON

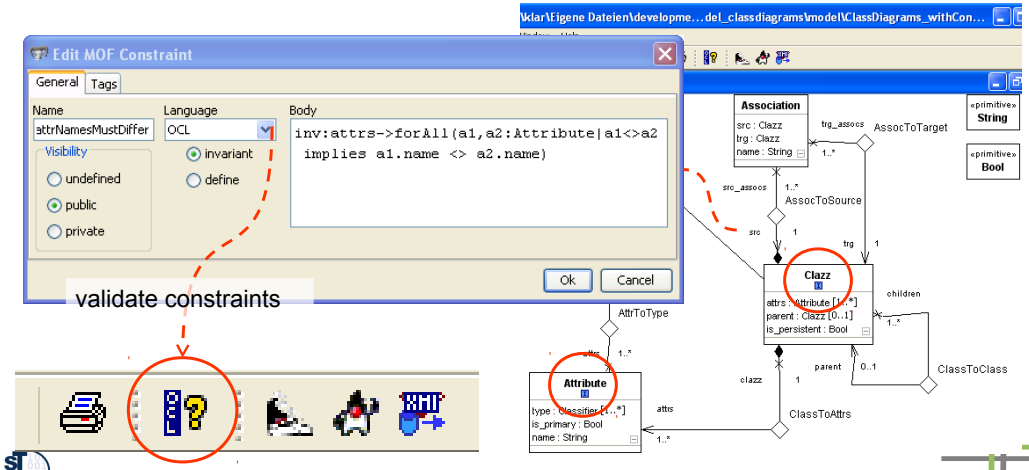


MOFLON MetaCASE – Main Features

- MOF2.0 editor (draw metamodels that comply to MOF2.0 standard)
  → build Domain Specific Languages (DSLs)
  - based on the CASE-tool framework Fujaba
  - possibility to extend MOFLON by own plugins
- interoperabilty (import / export)
- transform metamodel instances with model transformations (SDM, TGG)
- generate code (JMI-compliant) from DSLs
- instantiate models of the DSL (= repositories)
- basic editing support for generated repositories

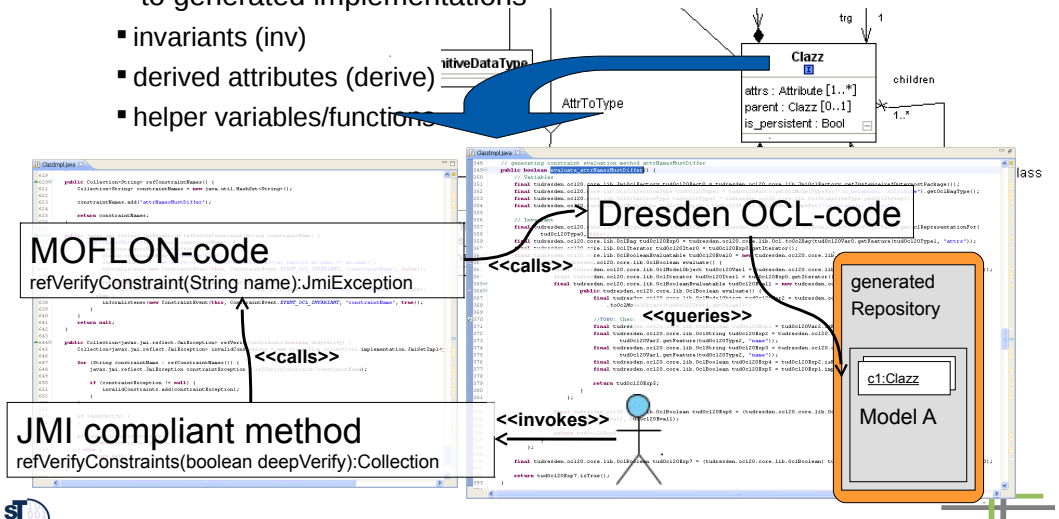
(OCL) Constraints in MOFLON – MOF Editor

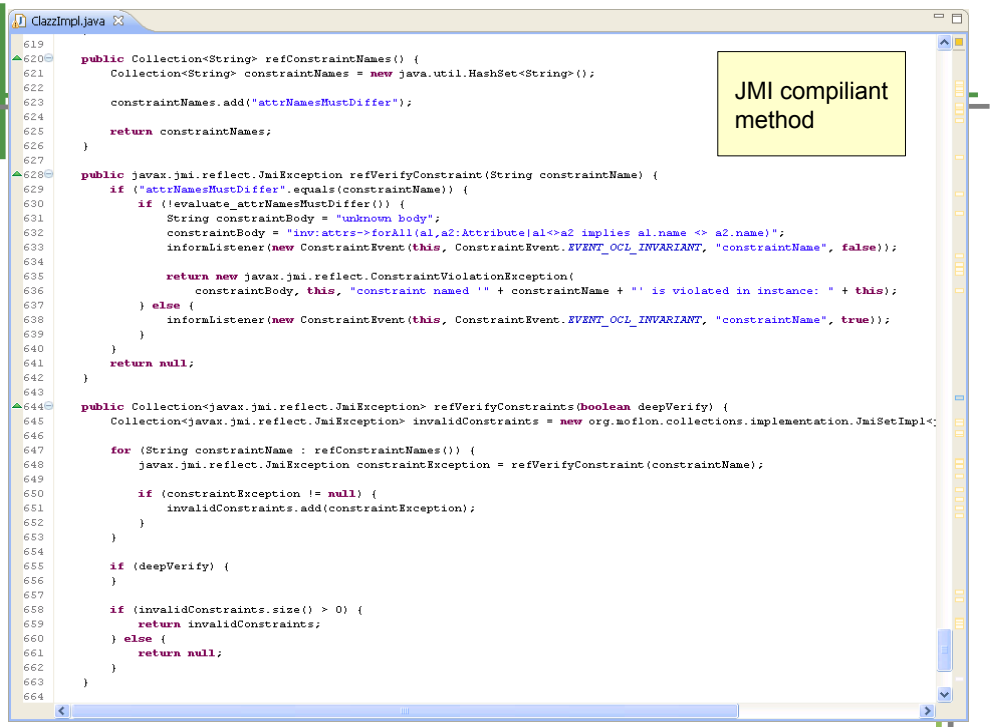
- MOF allows to add constraints to every MOF element
- MOFLON has an underlying MOF metamodel repository
- → MOFLON MOF editor may add constraints to elements

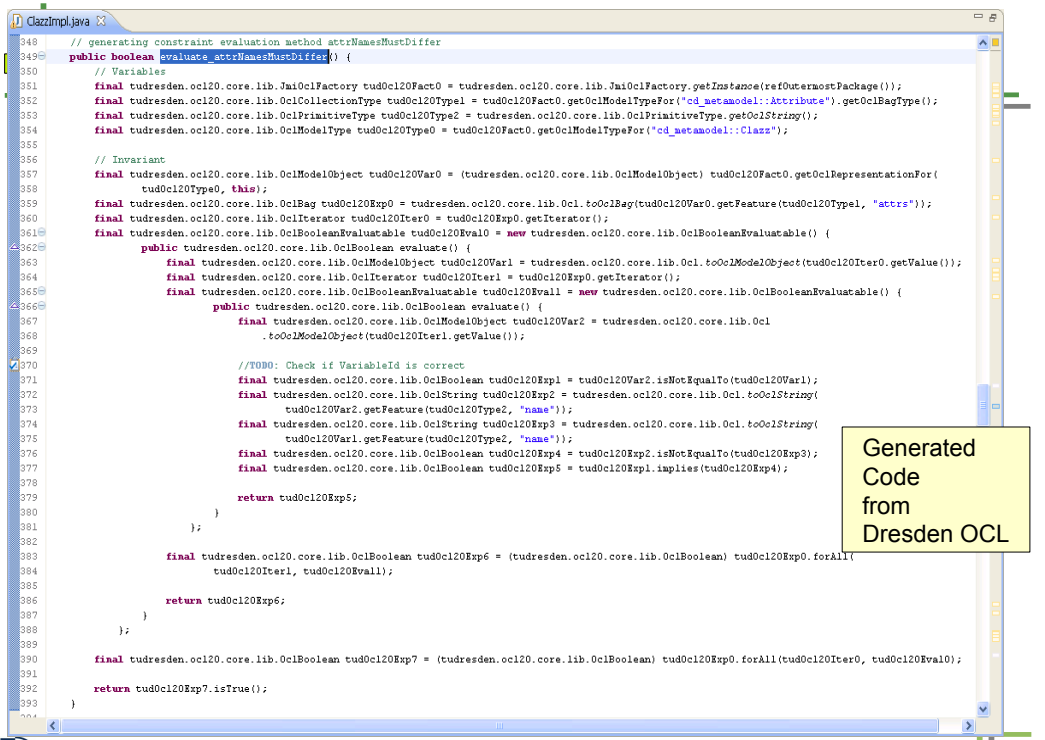


(OCL) Constraints in MOFLON – Generated Implementations

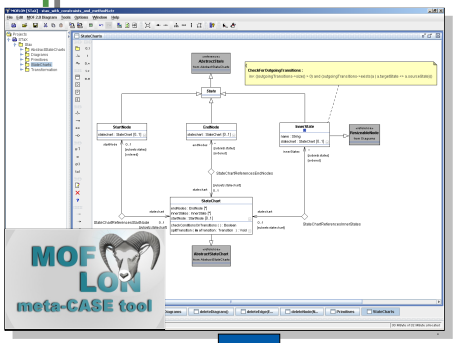
- MOFLON generates metamodel-based repositories (Java/JMI)
- MOFLON uses Dresden OCL to add constraint code to generated implementations
  - invariants (inv)
  - derived attributes (derive)
  - helper variables/functions







Result of MOFLON Example 1 – Statechart Editor (STaX)



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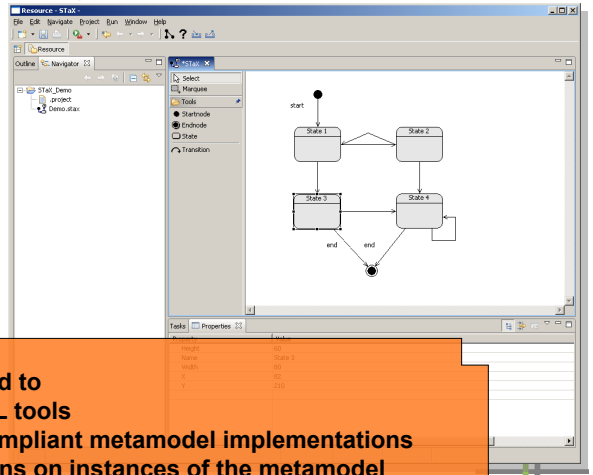
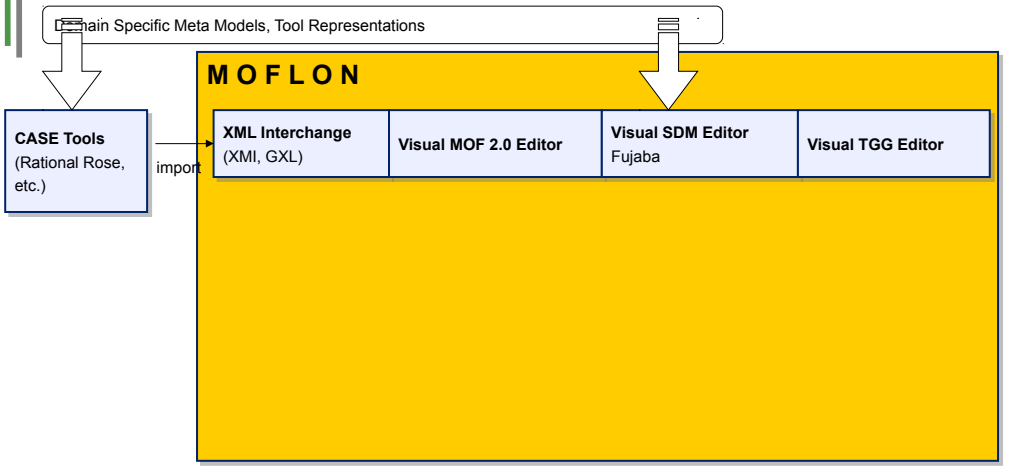
Editor:
- data structure (MOFLON repository)
- GUI (GEF)

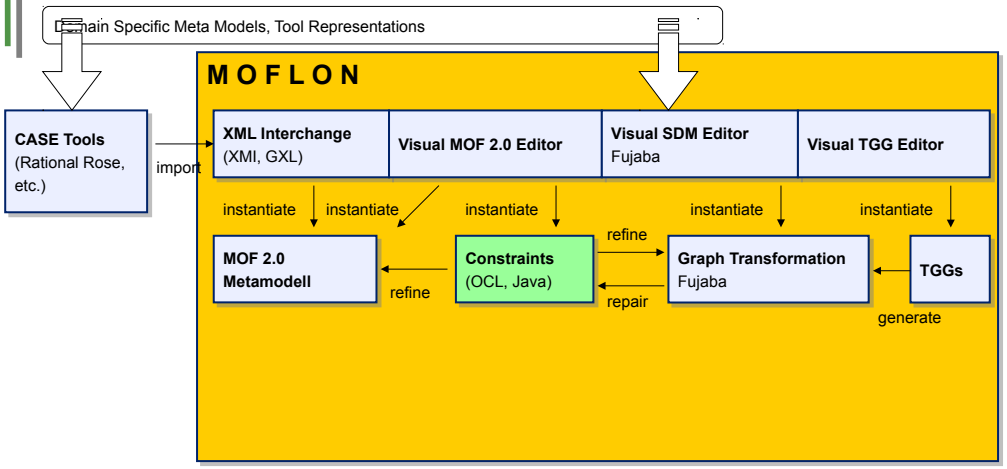


MOFLON is mainly used to
- **integrate existing DSL tools**
- **generate standard compliant metamodel implementations**
- **specify transformations on instances of the metamodel**

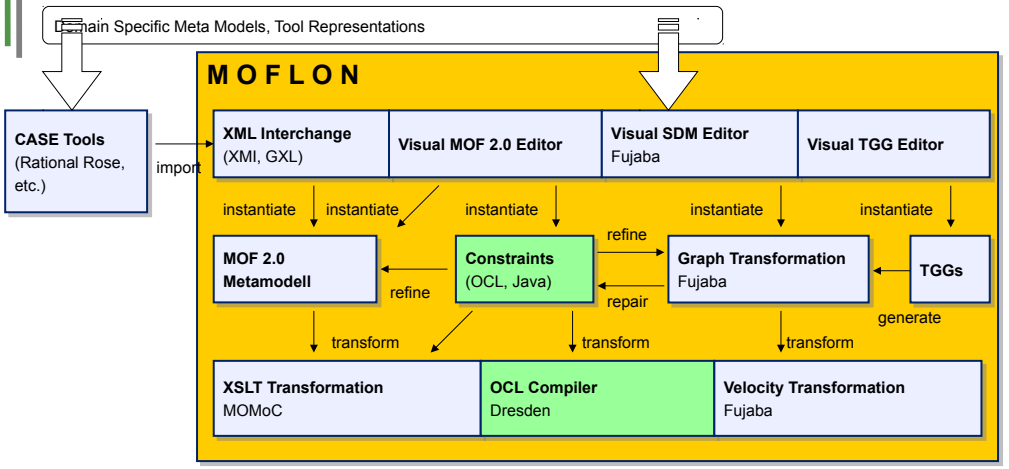
43.3.3 MOFLON – Architecture



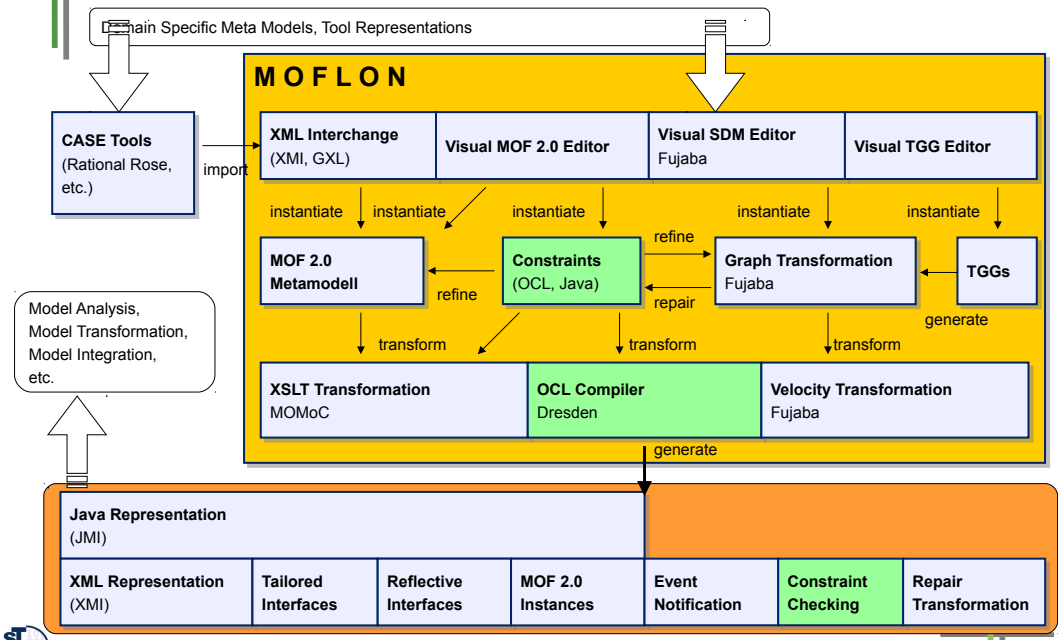
MOFLON – Architecture



MOFLON – Architecture



MOFLON – Architecture



43.3.4 Example 2: Integration with TGG – Object-Relational Mapping (ORM) from Class Diagrams to Database Schema

domain specific language,
e.g. Class Diagrams

domain specific language,
e.g. Database Schemata

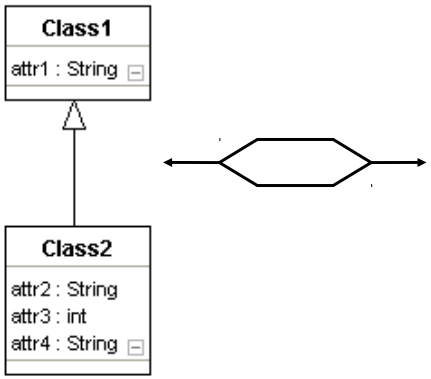


Table class1

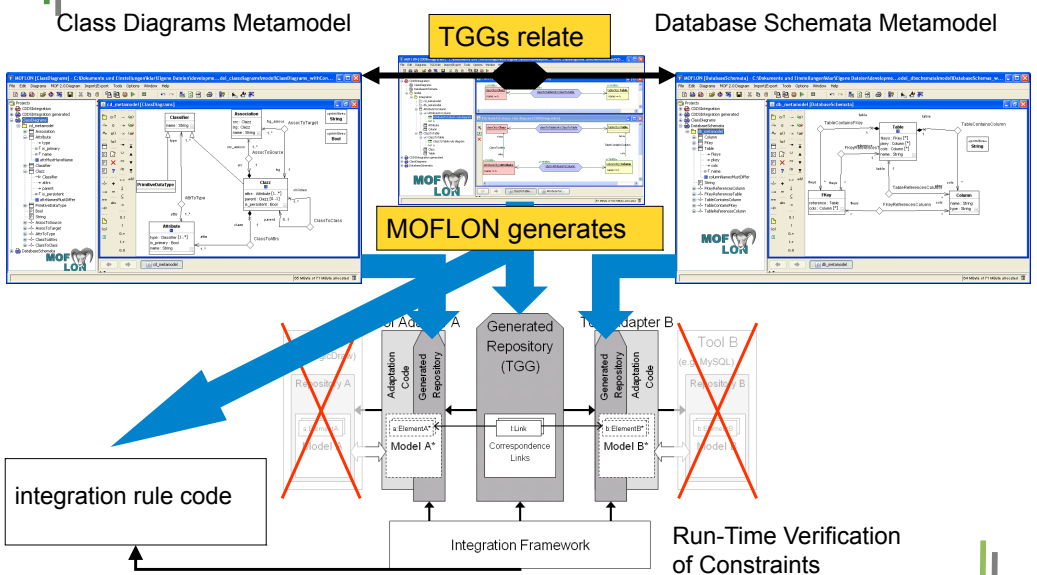
Server: localhost ▸ Database: icgt2008 ▸ Table: class1

Browse | Structure | SQL | Search | Insert

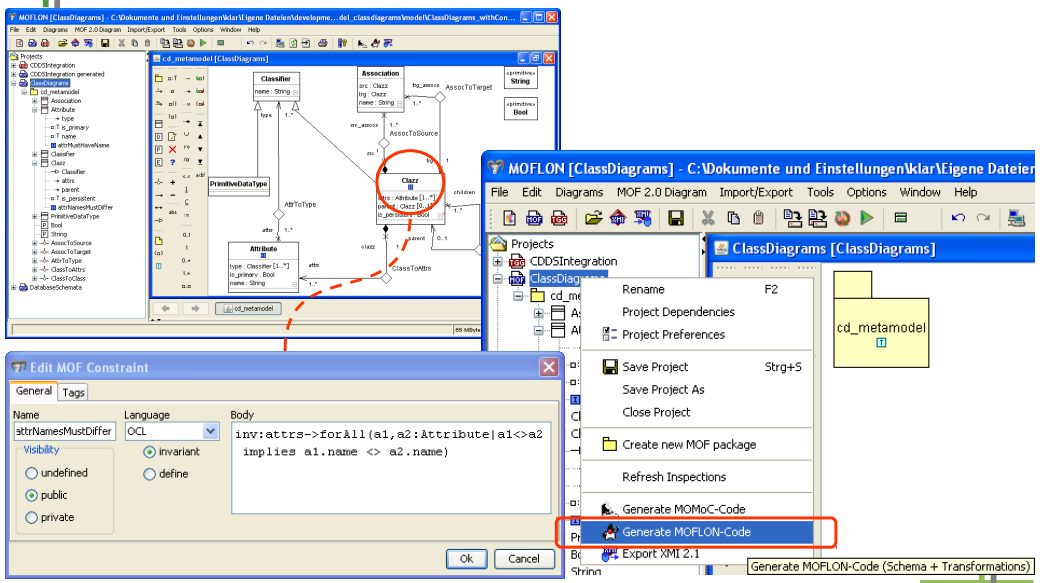
	Field	Type	Collation	Attributes	Null
☐	attr1	varchar(1024)	latin1_general_ci		No
☐	attr2	varchar(1024)	latin1_general_ci		No
☐	attr3	int(11)			No
☐	attr4	varchar(1024)	latin1_general_ci		No

Table class2

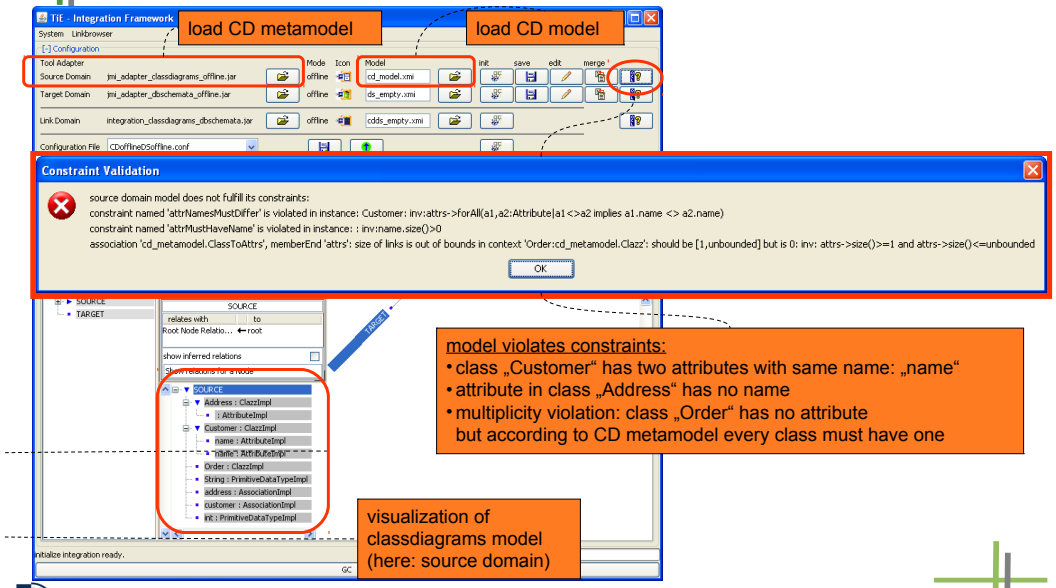
Example 2: Tool Integration Scenario TiE-CDDS: (ClassDiagrams / DatabaseSchema)



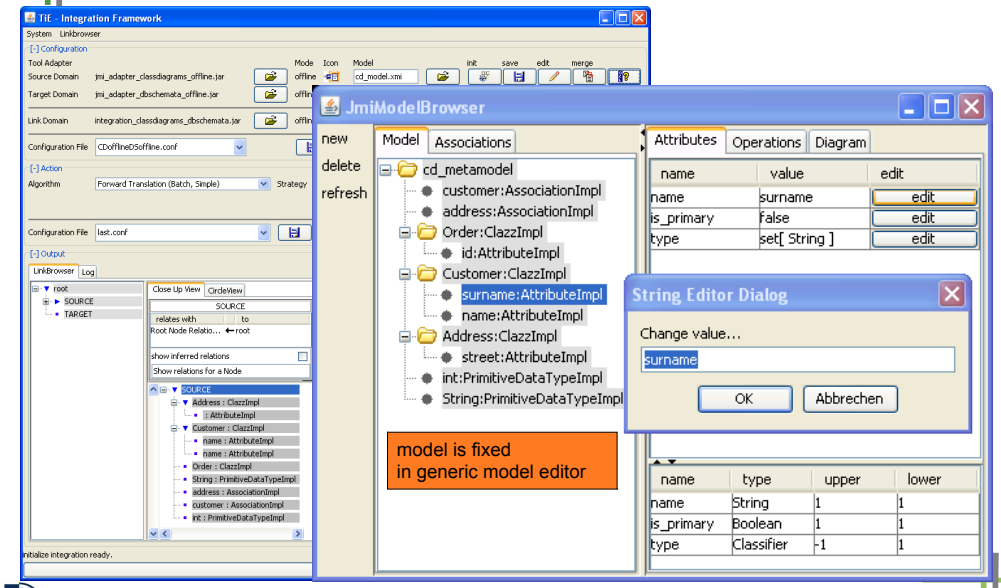
TiE-CDDS – Constraints in Class Diagrams (1) Generate Code from MOF model (CD metamodel)



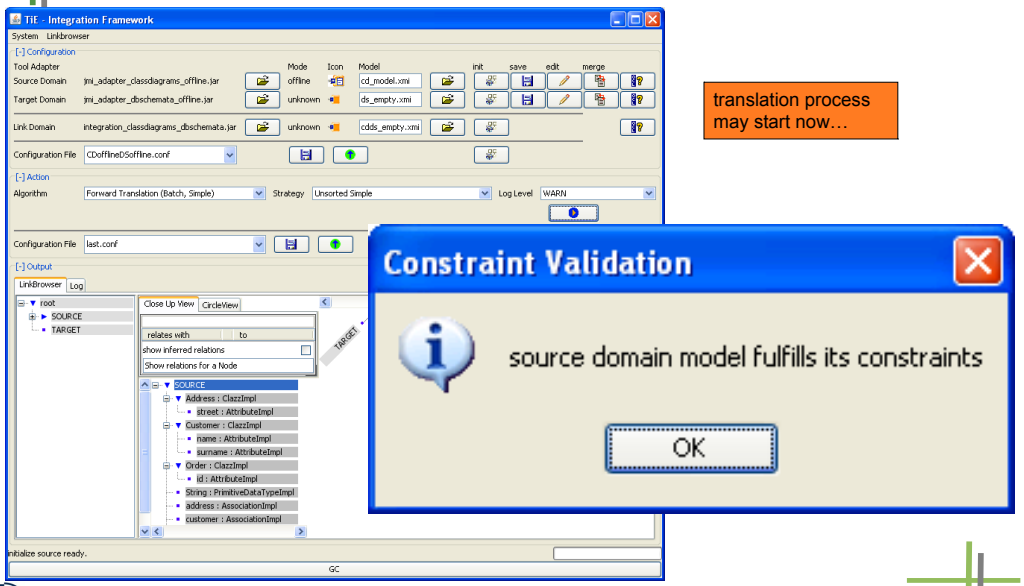
TiE-CDDS – Constraints in Class Diagrams (2)
Integration Framework



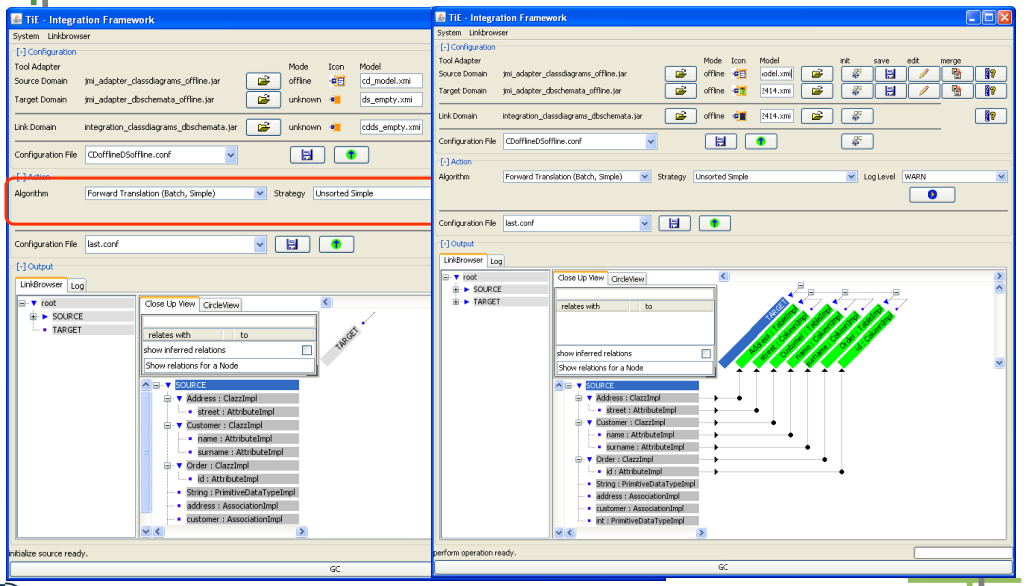
TiE-CDDS – Constraints in Class Diagrams (3)
Model Browser



TiE-CDDS – Constraints in Class Diagrams (4)
Integration Framework



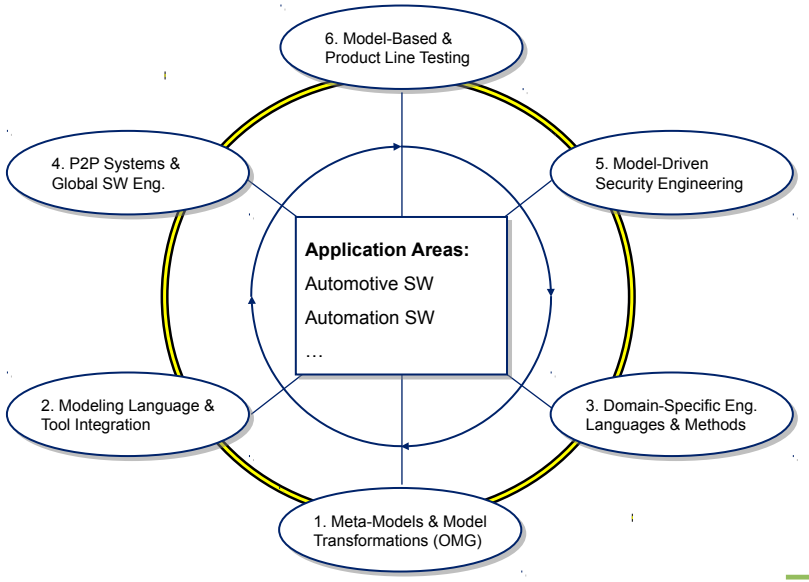
TiE-CDDS – Constraints in Class Diagrams (5)
Forward Translation to DB representation



Future Work – OCL

- We bootstrap our MOFLON MOF Metamodel periodically
  - Add more OCL constraints to our MOF Metamodel
  - Regenerate MOFLON MOF implementation
  - Activate constraint checking in MOFLON (Model verification, model consistency checking, model wellformedness)

Model-Driven Software Development at Real-Time Systems Lab (Prof. Schürr)



Related Approaches

	standards		approaches based on graph-/modeltransformation					classic meta-CASE approaches					text based approaches		
	MOF, OCL, QVT	MOFLON	Fujaba & TGG	Progres & TGG	GME & GReAT	EMF & Tefkat	ATOM^3	MetaEdit+	Microsoft DSL	EMF & GMF	Pounamu	DiaGen	EBNF & TXL	SQL	XML
Abstract syntax	+	+	+	+	o	o	o	+	+	o	+	+	+	o	+
Concrete syntax	--	--	--	+	+	--	+	+	+	+	+	+	--	--	--
Static semantics	+	+	o	+	+	+	o	o	--	+	o	+	o	o	--
Dynamic semantics	+	+	+	+	+	+	+	o	o	--	--	--	+	--	o
Model analysis	+	+	+	+	+	o	+	o	--	+	--	o	+	o	+
Model transformation	+	+	+	+	+	+	+	o	--	--	--	o	+	o	+
Model integration	+	+	+	+	o	+	--	--	--	--	--	--	o	--	o
Acceptability	+	+	o	--	o	+	--	+	--	o	+	o	o	--	+	+
Scaleability	+	+	--	o	--	o	--	o	--	--	--	--	--	--	o
Tool availability	--	o	o	+	+	+	+	+	o	o	+	+	+	+	o
Expressiveness	+	+	o	+	+	o	o	o	o	o	o	o	+	o	o

from Amelunxen, Königs, Rötschke, and Schürr,
„MOSL: Composing a Visual Language for a Metamodeling Framework“
in IEEE Symposium on Visual Languages and Human-Centric Computing (VLHCC 2006), September, 2006, 81-84

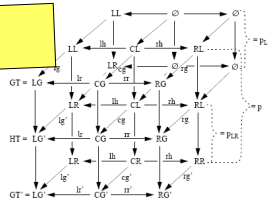
Further reading

- A. Königs, A. Schürr: "Tool Integration with Triple Graph Grammars - A Survey", in: R. Heckel (ed.), Proceedings of the SegraVis School on Foundations of Visual Modelling Techniques, Amsterdam: Elsevier Science Publ., 2006; Electronic Notes in Theoretical Computer Science, Vol. 148, 113-150.
- F. Klar, S. Rose, A. Schürr: "TiE - A Tool Integration Environment", Proceedings of the 5th ECMDA Traceability Workshop, 2009; CTIT Workshop Proceedings, Vol. WP09-09, 39-48
- F. Klar, S. Rose, A. Schürr: "A Meta-Model-Driven Tool Integration Development Process", Proceedings of the 2nd International United Information Systems Conference, 2008; Lecture Notes in Business Information Processing, 201-212.
- C. Amelunxen, A. Königs, T. Rötschke, A. Schürr: "MOFLON: A Standard-Compliant Metamodeling Framework with Graph Transformations", in: A. Rensink, J. Warmer (eds.), Model Driven Architecture - Foundations and Applications: Second European Conference, Heidelberg: Springer Verlag, 2006; Lecture Notes in Computer Science (LNCS), Vol. 4066, Springer Verlag, 361-375.
- A. Königs: "Model Integration and Transformation - A Triple Graph Grammar-based QVT Implementation", Technische Universität Darmstadt, Phd Thesis, 2009.

The End

Some slides are courtesy Florian Heidenreich and Felix Klar

Thank you for your attention…



MOFLON

http://www.moflon.org