Domain Specific Languages (DSL)

-

Status Quo

Arif Chughtai

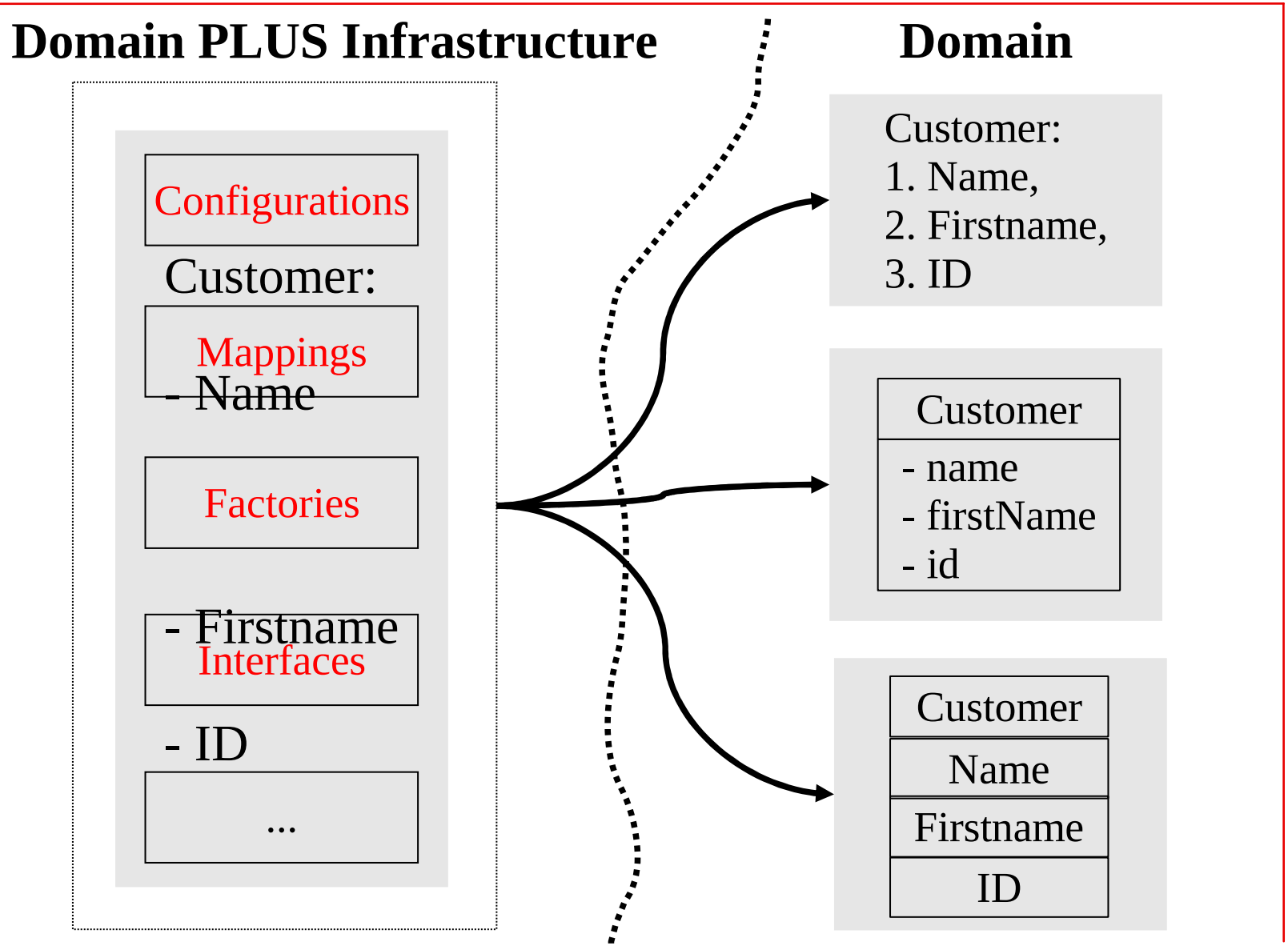
Speaker

- Arif Chughtai
  - Diplom-Informatiker (**M.Sc.**) - IT-Consultant
  - mail@arifchughtai.org, www.arifchughtai.org

Agenda

- Motivation
- Concepts
- Status Quo (DSLs, Products & Standards)
- Example
- Resources

Motivation


Domain PLUS Infrastructure
Domain
Configurations
Customer:
Mappings
- Name
Factories
- Firstname
Interfaces
- ID
...
Customer:
1. Name,
2. Firstname,
3. ID
Customer
- name
- firstName
- id
Customer
Name
Firstname
ID

Motivation

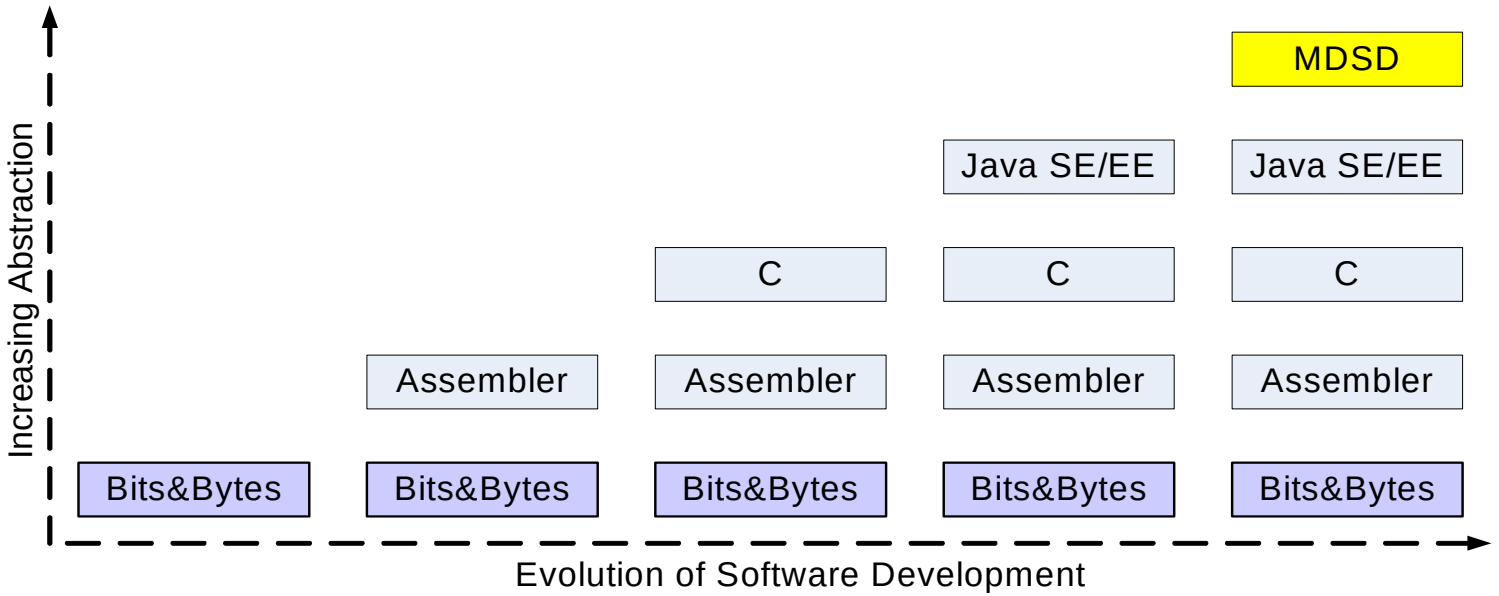
- Domain Driven Desing (DDD) is upcoming
- Demands
  - Move software-development closer to domains
  - Separate domain aspects from technical ones
- Enhancement of tools and platforms enable utilization of well known concepts like DSLs

Motivation

- Ongoing change/shift of
  - Technologies
  - Requirements
- Increasing complexity
- Architecture and models have to be regenerated
  - Lot of avoidable Efforts
  - Important thinks are neglected
- New generation infrastructure platforms doesn´t help

Motivation

- More adequate paradigm is needed
- Model Driven Software Development (MDSD, MDD)
  - DSLs are integral part
- Further step of abstraction (well known :-)



Concepts

- Domain
  - Insurance, health care, embedded systems, software architecture,...
  - Ex. Domain „Private Banking“: „Customer“, „Account“,...
- Domain models are expressed by DSLs
  - DSLs capture relevant properties of domains formally
  - Analysis of domain is required

Concepts: DSL Key Characteristics

- Limited in scope
- Limited in cabability
- Small and simple
  - 'little languages'
  - 'mini-languages'
- Often turing incomplete

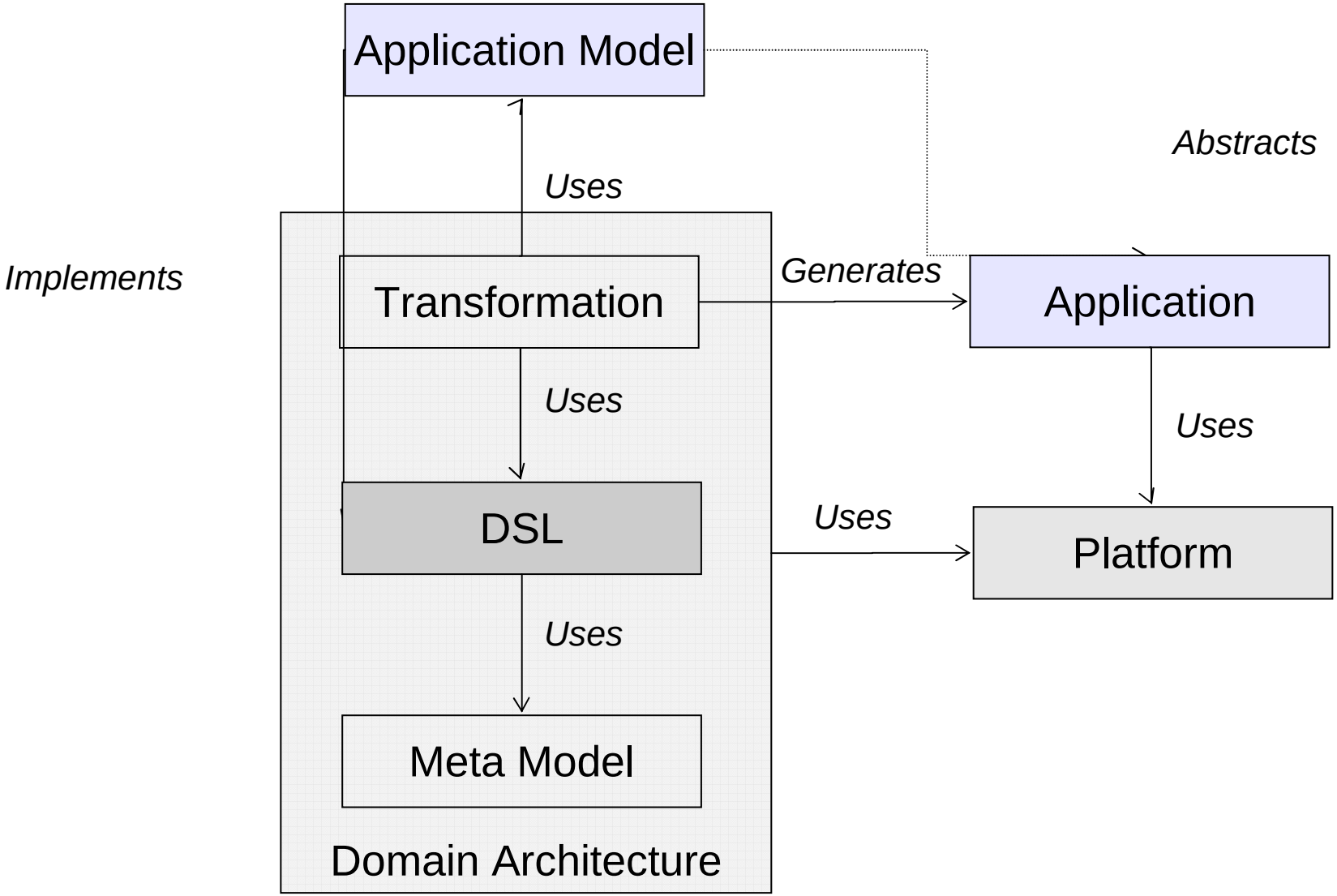
Concepts: DSL Key Characteristics

- General Purpose Languages (GPLs) vs. DSLs
  - Java,... vs. PHP,...
- External vs. internal DSLs
  - DSL defined via oAW,... vs. Ruby,...
- Vertical vs. horizontal DSLs
  - lex/yacc,... vs. SQL,...
- Technical vs. business related DSLs
  - DSL describing technical platform,... vs. DSL describing business

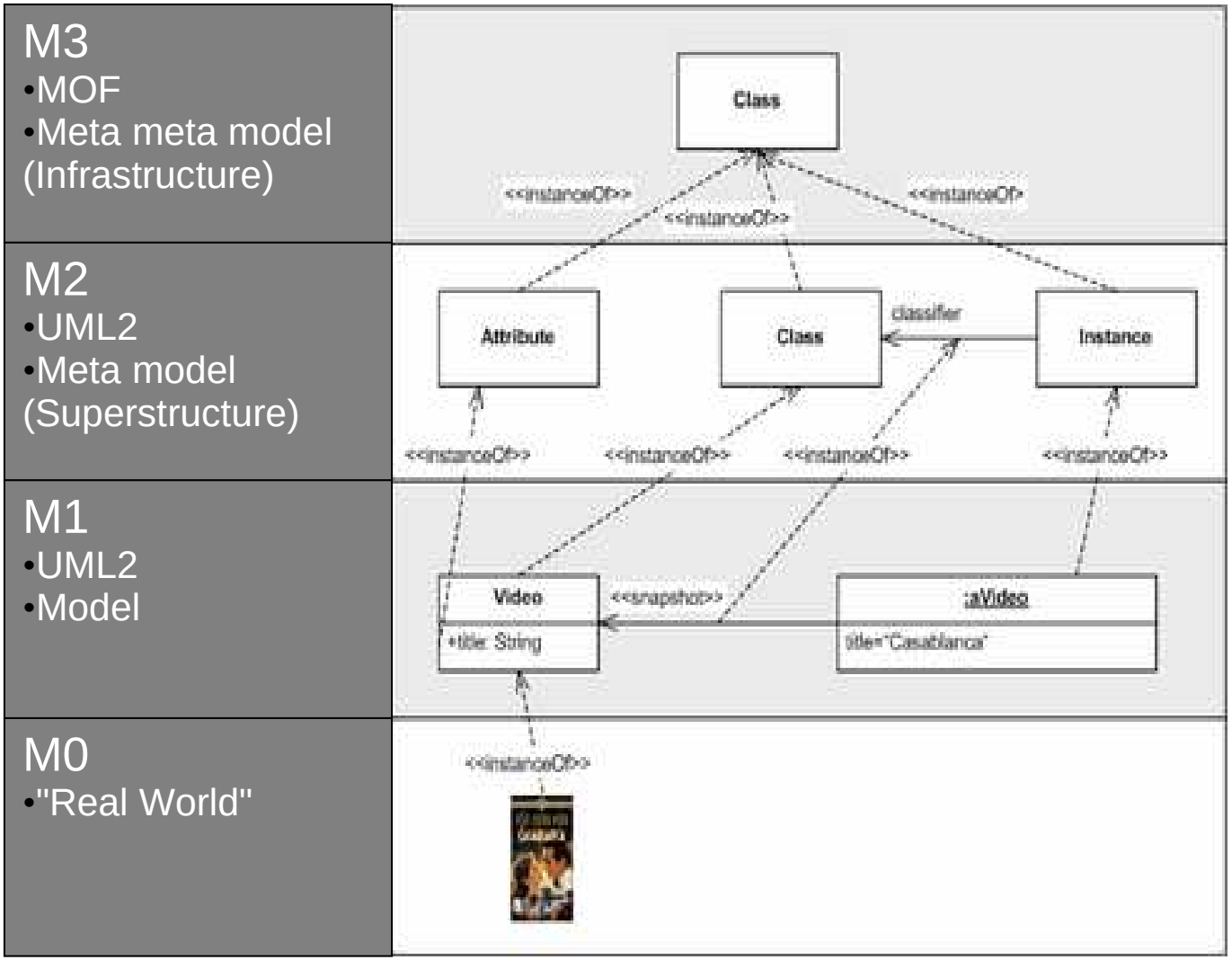
Concepts

- DSLs are essential part of MDSD
- Different notations
  - Graphical
  - Textual
  - Tabular
  - ...

Concepts: MDSD Context

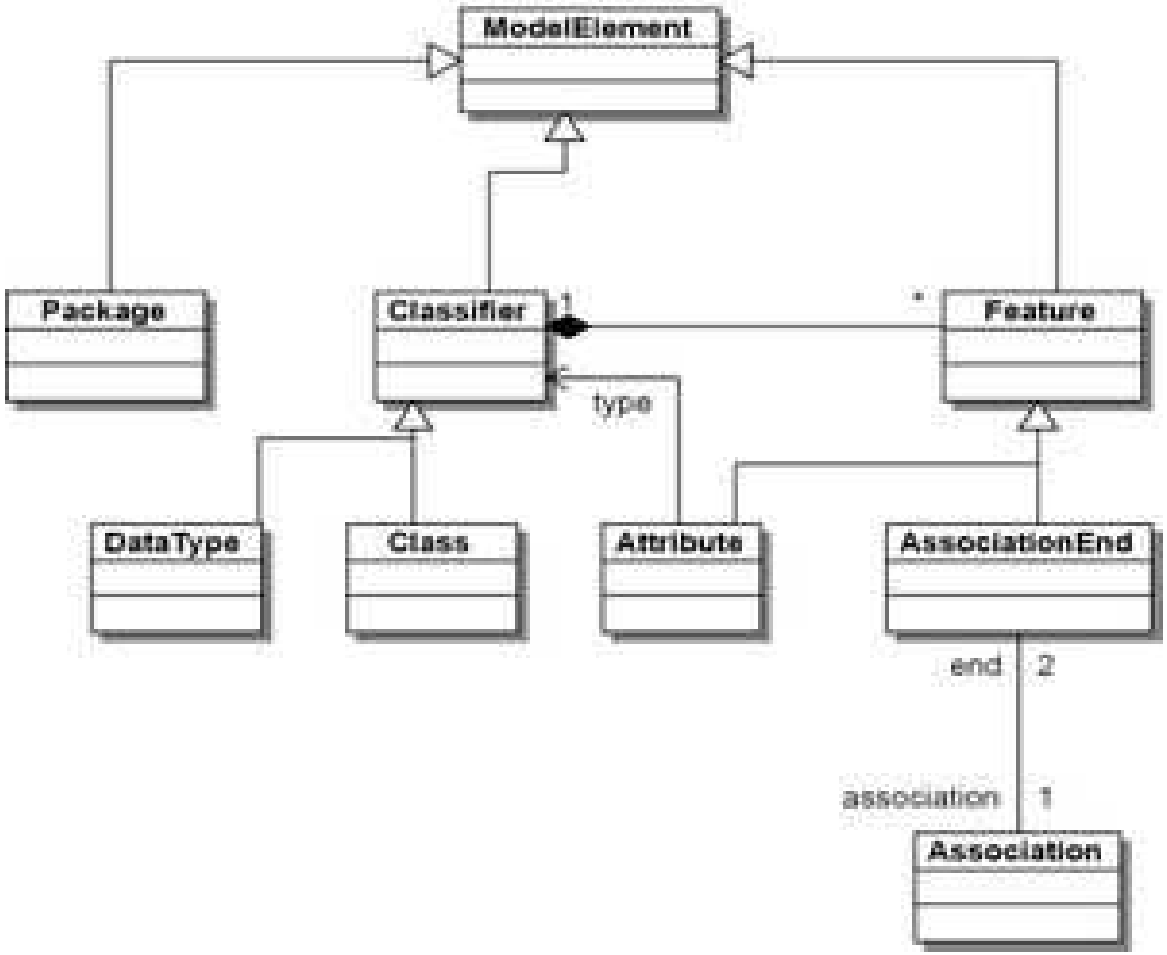


Concepts: MOF



[Source: http://de.wikipedia.org/wiki/Meta-Object_Facility]

Concepts: MOF



[Source: http://de.wikipedia.org/wiki/Meta-Object_Facility]

Concepts: Overview

- Abstract syntax (meta model)
  - Describes another model (structure and semantics)
  - Ex. description of oo-concept class
- Concrete syntax (notation/representation)
  - Implementation of abstract syntax
  - Ex. UML2 class diagramm
- DSLs comprise abstract and concrete syntax
  - Metamodel (level M2)

Concepts: Overview

- Static semantic
  - Constraints ensuring model is well-formed
- Semantic
  - Describes semantic of model
- Transformation
- Platform
- Application model
- Definition of new DSL requires at least
  - Abstract syntax
  - Editor
  - Generator

Status Quo

- Concepts and technologies are there
- It ist not clear exactly what is or isn't a DSL?
  - DSL vs. fluent interface
  - DSL vs. UML
  - DSL vs. scripting languages
  - DSL vs. GPL
  - ...
- Many technical DSLs
- Struggle for standards

Status Quo: UML

- UML2 vs. DSLs
- Lot of vendors support UML2
- Some vendor(s) does not
  - Microsoft ;-)

Status Quo: Standards

- XML
- UML2
- XMI
- MOF
- OCL
- ATL/QVT
- ...

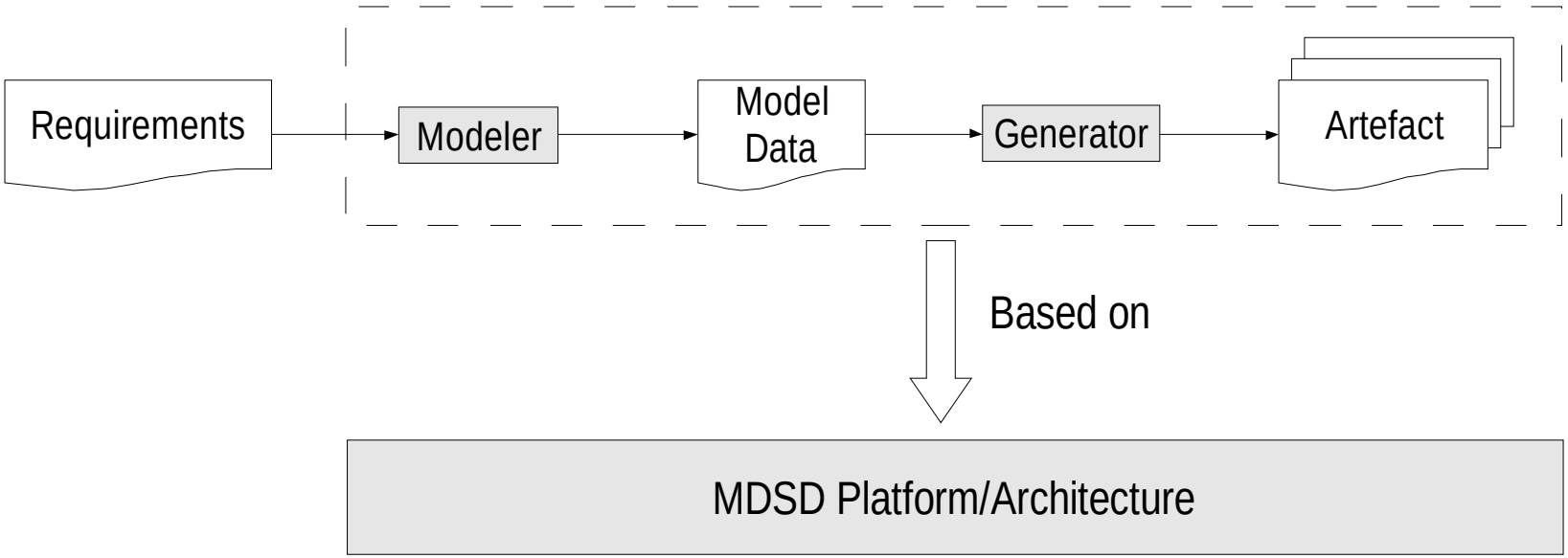
Status Quo: DSLs

- UML2
  - Extendable GPL
  - Strong tool support
- Many textual DSLs
  - Scripting languages like Ruby, Groovy, Lisp,...
  - Regular Expressions
  - Pattern-Scanner Awk
  - Xtext
  - ...

Status Quo: Tools: Differentiation

- UML Modeler
- DSL Editors (textual and graphical)
- Generators
- MDSD-Frameworks

Status Quo: Tools



Status Quo: Tools: Selection Criteria

- Support of standards
  - MOF, XMI, UML2 incl. UML profiling
- Transformations as "First Class Citizens"
- Support of MDSD best practises
- (Protected regions!)
- Integration with other tools

Status Quo: Tools: UML

- Magic Draw
- Poseidon
- Omondo
- Visual Paradigm
- ...

Status Quo: Tools: MDSD

- Eclipse
  - Eclipse Modeling Framework (EMF)
    - Ecore equivalent of MOF
  - Open Architecture Ware (oAW)
- IBM
  - Rational Software Architekt (RSA)
- Microsoft
  - Domain-Specific Language Tools
  - Microsoft Visual Studio 2008/.NET Framework 3.5

Status Quo: Tools: MDSD

- ArcStyler (Interactive Objects)
- Optimal J (Compuware)
- AndroMDA
- Velocity
- …

Example: oAW

- Powerfull MDSD tool suite
- Open Source
- 100 % Java

Example: oAW

- Since version 4.1 hosted inside Eclipse
  - Generative Modeling Technologies (GMT) project
- Download site
  - www.eclipse.org/gmt/oaw/download
- Large and stable community
- Industry proven

Example: oAW: Feature List

- UML2 meta model and XMI
- Template/Expression languages
- Different kinds of models can be processed
- Arbitrary export formats (java, xml, php,...)

Example: oAW: Feature List

- Comprehensive documentation (samples, tutorials,...)
- Support of major UML2 tools (RSA, Magic Draw, Eclipse UML2, Poseidon,...)
- Tool integration (Ant, Eclipse)
- Ready to use templates/cartridges for specific platforms/issues
- ...

Example: oAW: Release 4.2 Features

- Compatible with...
  - Eclipse 3.3 Europa release and the corresponding EMF 2.3, UML2.1 and GMF 2.0!
- Debugger for Xpand and Xtend fully integrating Eclipse's debugging facility
- Supports Product Line Engineering (PLE) on generator level
- Xtext with many more options
- ...

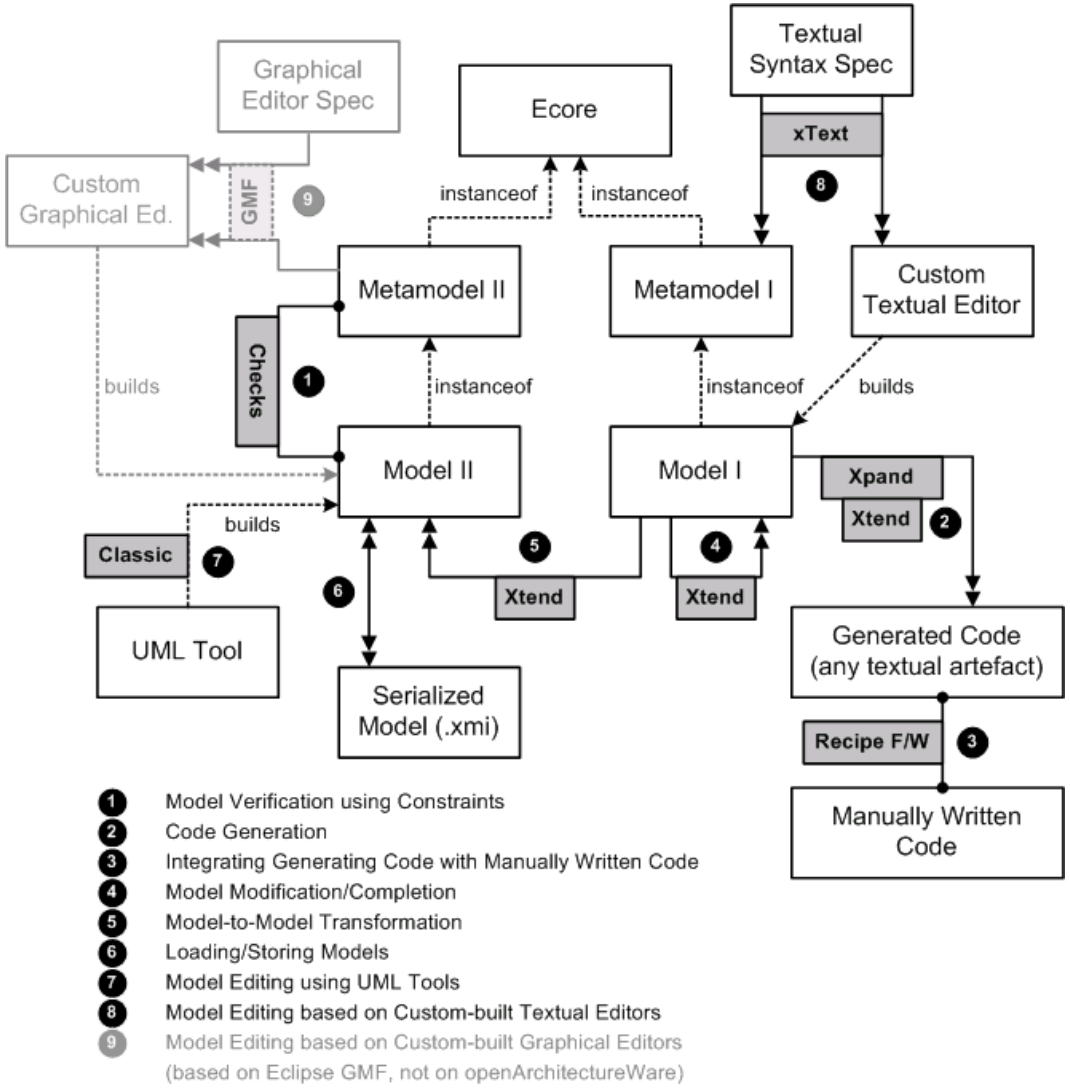
Example: oAW: Eclipse Plugin

- Language specific editors
- Views
- Project Wizards
- Menu Items

Example: oAW: Languages/Frameworks

- Xpand
  - Code generation
- check
  - Model validation
- Xtend
  - Extension of meta model elements
- Xtext
  - Creation of external textual DSLs
- Expression framework builds base

Example: oAW: Big Picture



[Source: http://www.eclipse.org/gmt/oaw/]

Example: oAW: Xpand

- Template language for iterating model structures

- Simple and intuitive
- 3 key elements
  - Identifier, meta model properties and constant text

- About 30 identifier
- Supports polymorphism
- Template file: `FileName.xpt`

Example: oAW: Xpand: Key identifier

- Template
  `<<DEFINE field FOR Class>> ... <<ENDDEFINE>>`
- Template execution
  `<<EXPAND field FOREACH Attribute>>`
- Condition `<<IF>> ... <<ENDIF>>`
- Loop `<<FOREACH>> ... <<ENDFOREACH>>`
- File output `<<File NameS+".java">>`

Example: oAW: Xtext

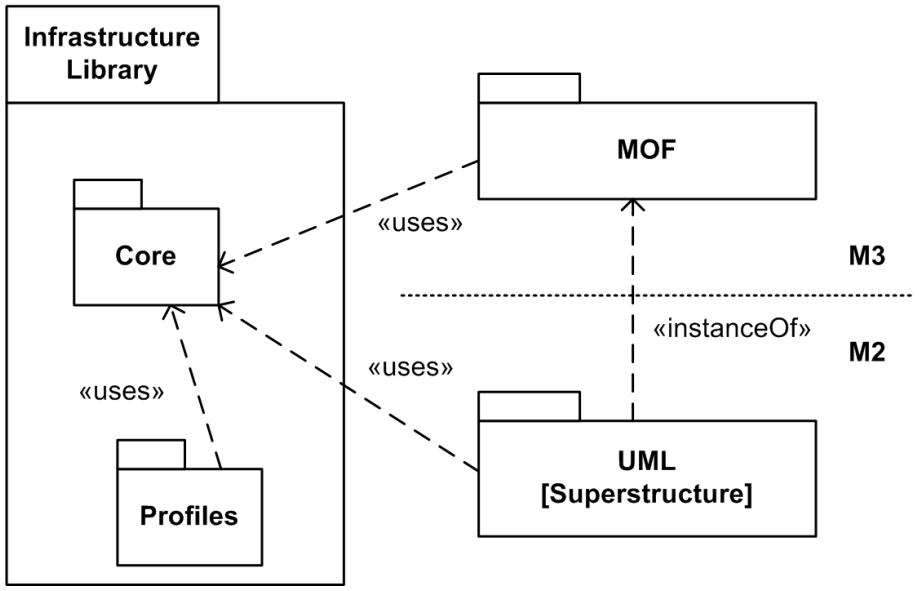
- Expression language/framework for generating textual DSL and corresponding editors
- Rules are used to define DSL
- Rules follow EBNF grammar

```
RuleName:
    RuleExpression;
```

- Grammar definition file: `FileName.xtxt`

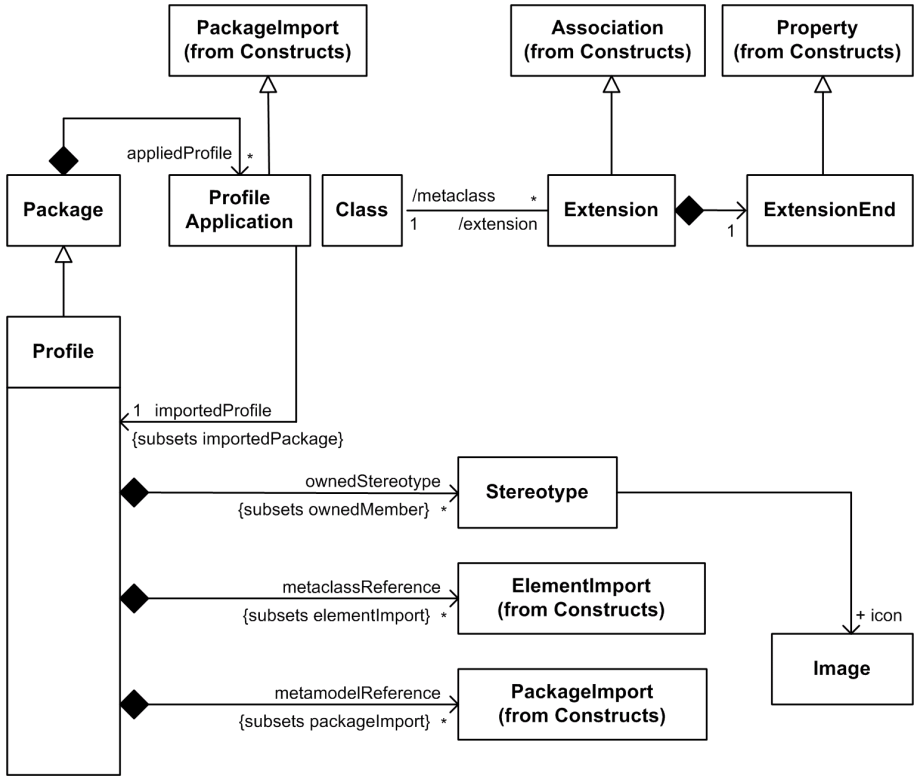
Example: UML

- To use UML2 as DSL it must be extended
- Heavy-weight extension
  - Extension of UML2 meta model
  - Completely new model concepts
  - Refinement of existing model concepts



Example: UML

- Light-weight extension
  - UML2 profile mechanism (stereotypes)
  - No impact on UML2 meta model
  - Existing model concepts are complemented



Resources: Books

- Stahl, Thomas and Völter, Markus (2006): Model-Driven Software Development - Technology, Engineering, Management; Wiley
- Vogel, Oliver et al. (2005): Software-Architektur - Grundlagen, Konzepte und Praxis; Spektrum
- Evans, Eric (2003): Domain-Driven Design; Addison Wesley

Resources: Web

- General MDSD
  - www.mdsd.info
  - www.modelbased.net
  - www.modelware-ist.org
- Code Generation Network
  - www.codegeneration.net
- Object Management Group
  - www.omg.org/mda
  - www.omg.org/technology/documents/formal/uml.htm

Resources: Web

- Book of Stahl, Thomas and Völter, Markus
  - www.mdsd-buch.de
- Book of Vogel, Oliver et al.
  - www.software-architektur-buch.de

Resources: Web

- Wikipedia
  - http://en.wikipedia.org/wiki/Domain_specific_language
- Martin Fowler
  - http://martinfowler.com/articles/languageWorkbench.html
- Markus Völter
  - www.voelter.de/services/mdsd.html
- Walter Kriha
  - www.kriha.de

Resources: Web

- openArchitectureWare
  - www.openarchitectureware.org
  - www.eclipse.org/gmt/oaw
  - www.architectureware.de
  - http://www.eclipse.org/gmt/oaw/doc/4.3/html/contents/xtext_reference.html
  - http://oaw-forum.itemis.de

Resources: Web

- Eclipse Modeling Project (EMP)
  - www.eclipse.org/modeling
- Eclipse Generative Modeling Tools (GMT) Project
  - www.eclipse.org/gmt