Complementing MDD for the Detection of Software Architecture Erosion

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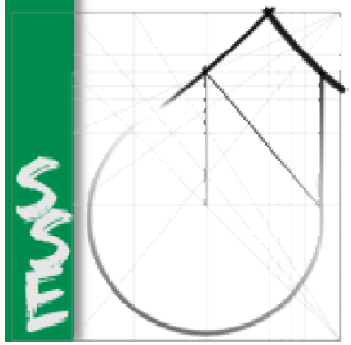

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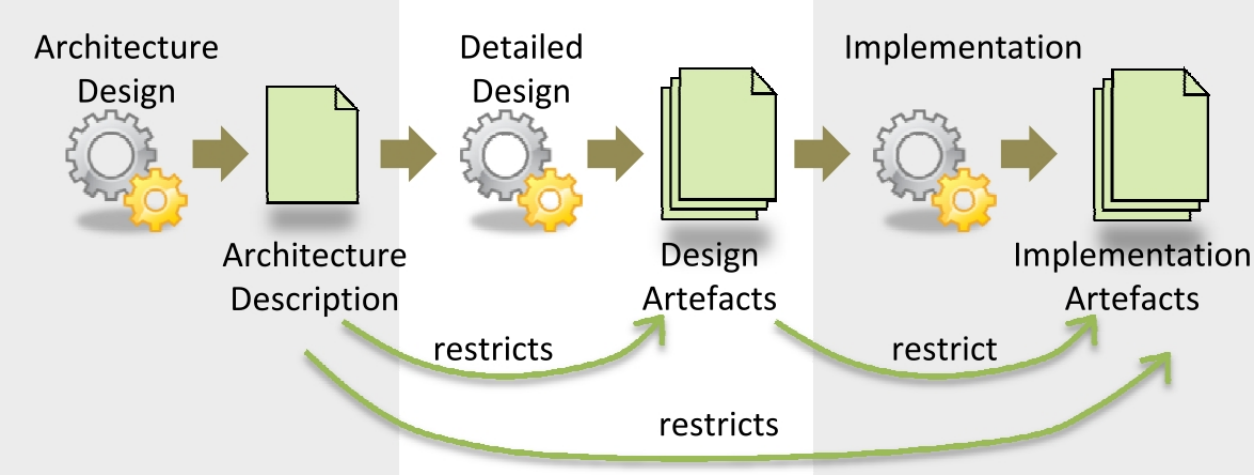
Motivation: Software Architecture Erosion

Software Architecture Erosion:
the (progressive) process of divergence between the realization of a software system and its architecture.

Software Architecture Conformance:
Refinment and realization of a system conform with the intended architecture.

Erosion happens in MDD, too!



- The intended architecture of a system restricts its refinement and implementation
- Erosion means violation of these **architectural rules**
- Can partially be addressed by model transformation and consistency checking techniques

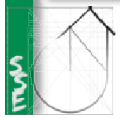
```
module Arch2Design
create OUT : UML from IN : Arch
rule Layer2Package {
  from
    l : Arch!Layer
  to
    p : UML!Package (
      name <- l.name
      ownedRule =
      'Nothing in this package depends on
       something contained in a package
       created as result of the transfor-
       mation of a layer above l')
}
```

Goals of our work

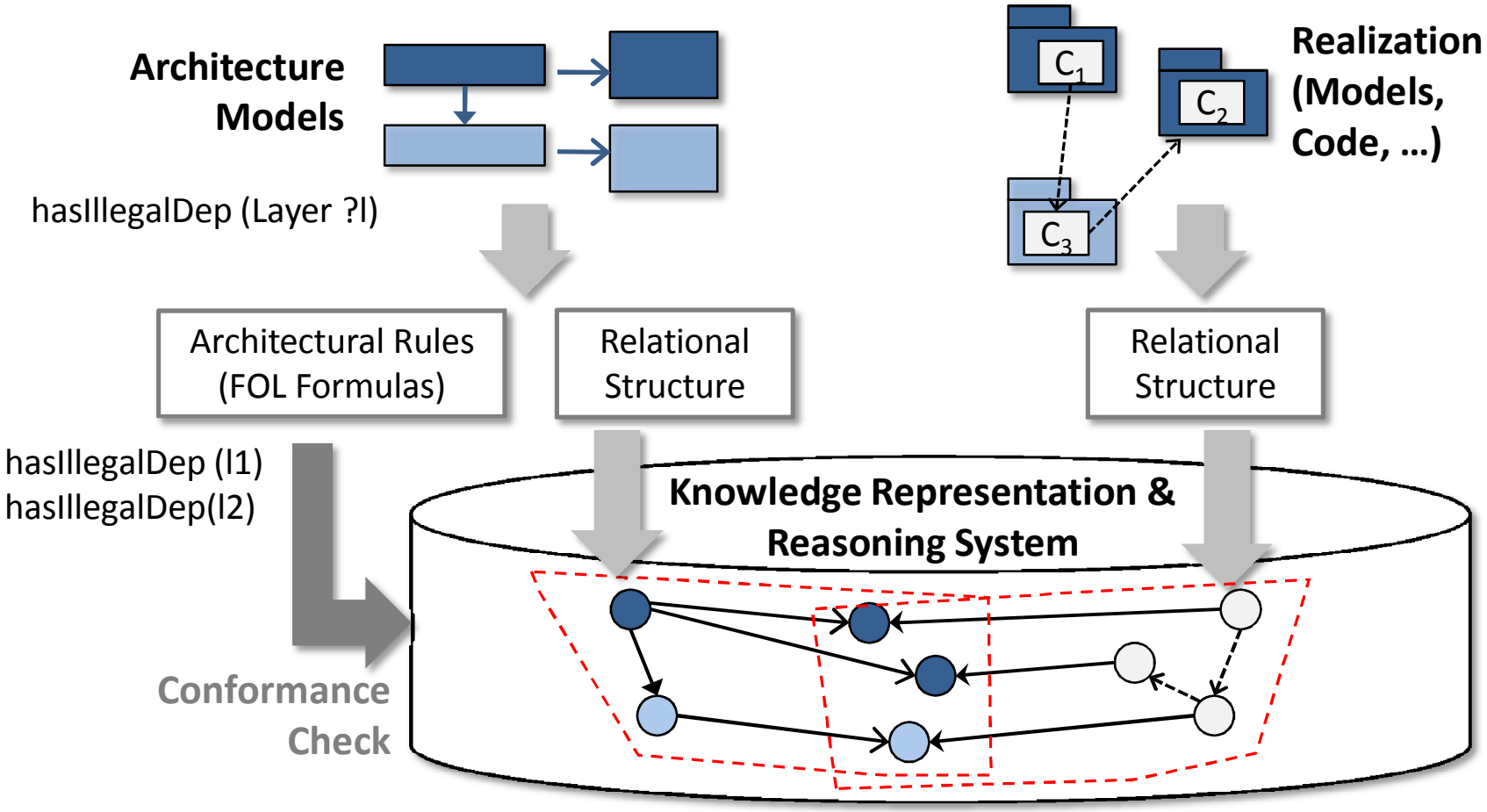
- We want to…
  - … complement MDD for detecting software architecture erosion
  - …make architecture conformance checking more flexible w.r.t.
    - Support of different artefact types and
    - Checkable architecture aspects
  - … enable architects/developers to detect erosion more efficiently and to stick to their architectures more easily.

How to Detect Erosion – Related Approaches

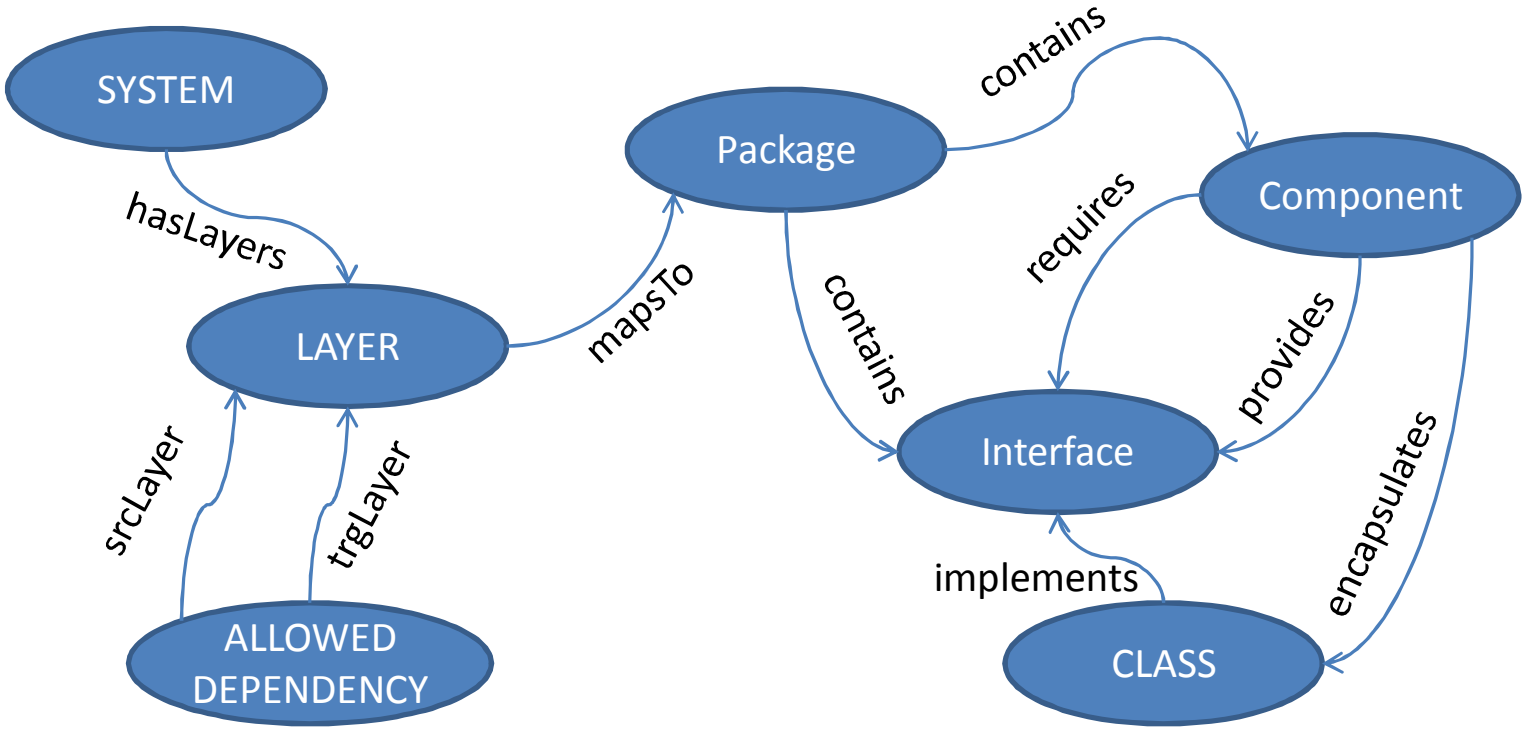
- From Model-Driven Development Research
  - Model transformation techniques
  - Consistency checking techniques
- From Software Architecture Research
  - Dependency structure matrices
    - Focusing on single architecture aspect: dependencies between modules
  - Reflexion Modelling
    - Focusing on single architecture aspect: dependencies between modules
  - Code Query Language-Based Approaches
    - Rarely integrated into MDD approaches



Main Concepts of the Proposed Approach

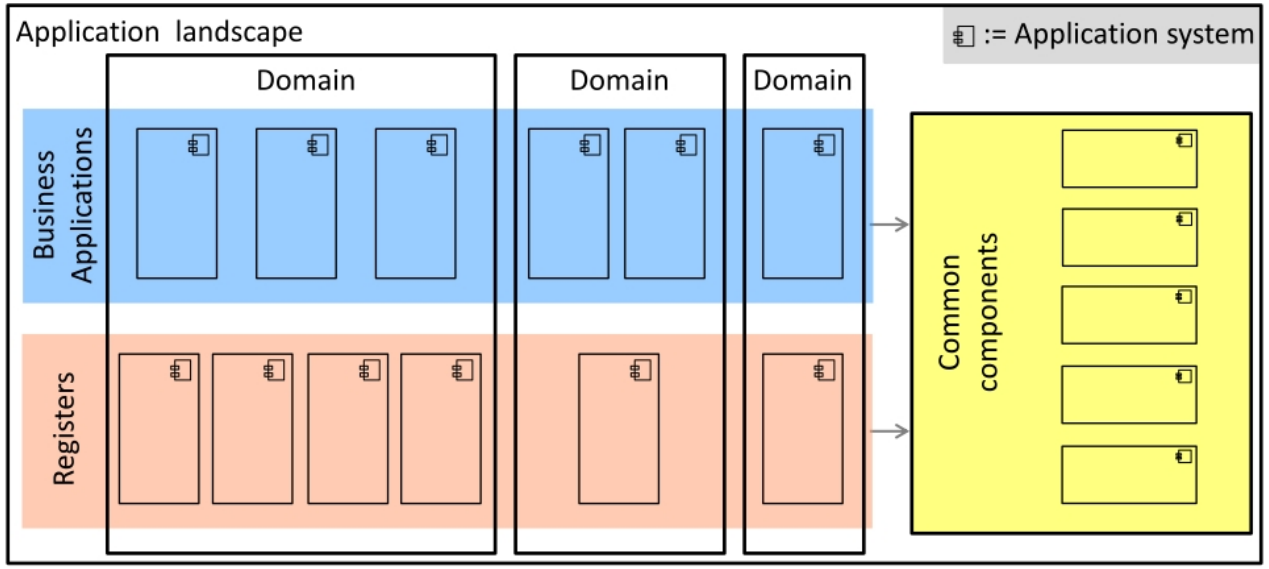


Architectural / Component-Based Ontology



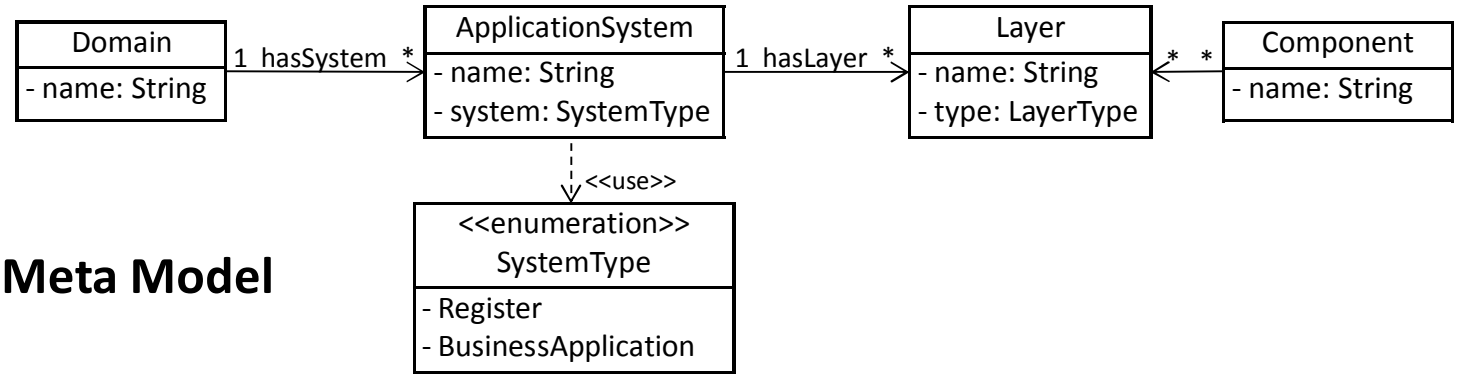
Case Studies – Domain-Specific Reference Architectures

- Investigated Reference Architecture: The Register Factory
- Common Reference Architecture for applications of the German public administration



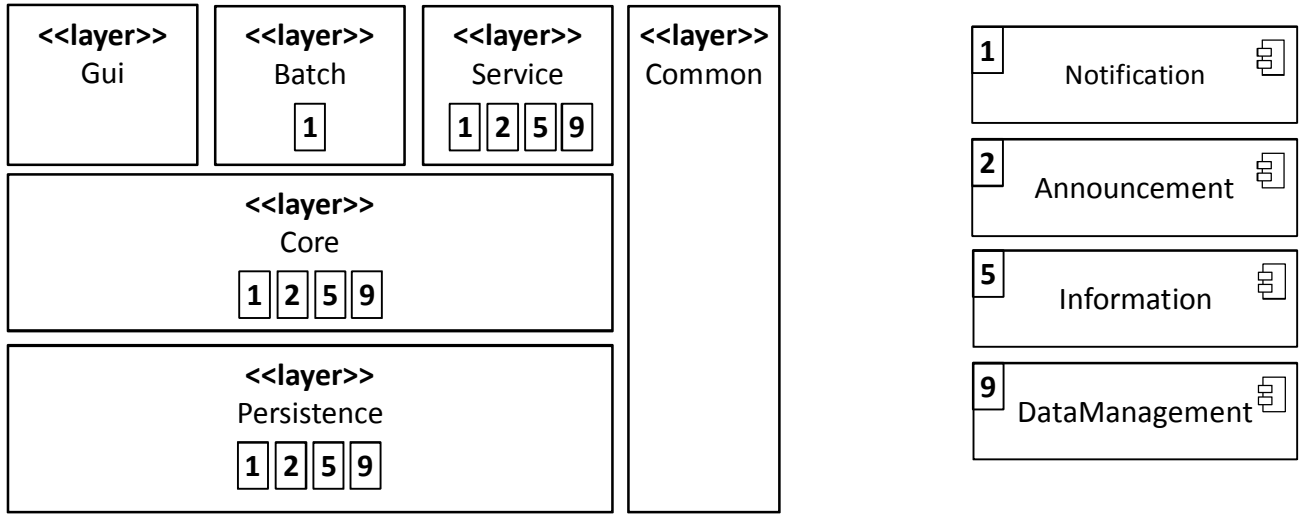
- Architectural Aspects: 6 different patterns of the Register Factory
- Checked Artefacts: 60 KLOC Java Code + Spring XML data

Preparing the Register Factory for Checking – Architecture Meta Model



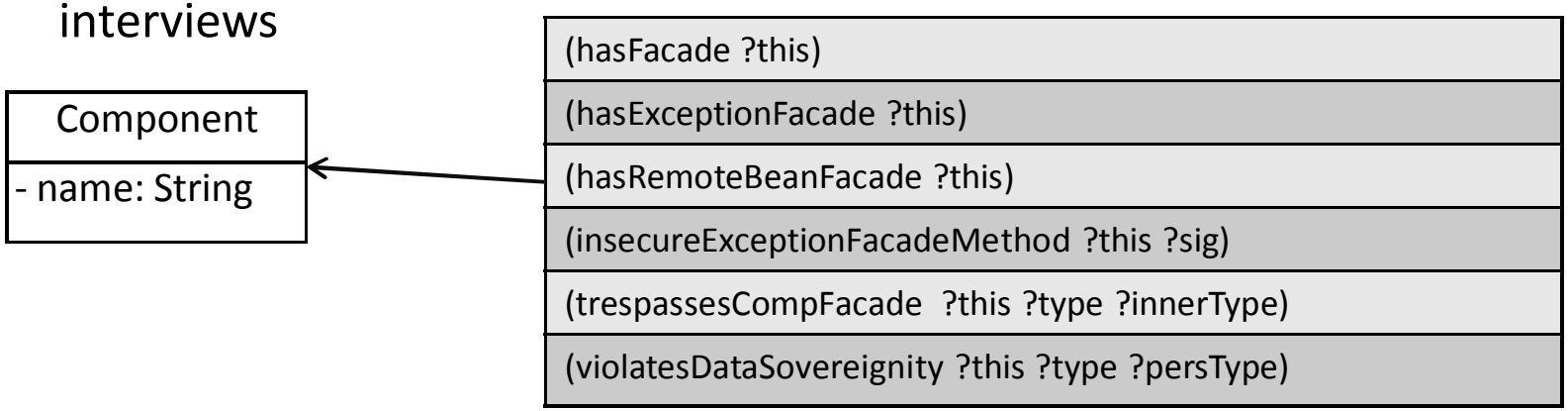
Meta Model

Instance (Intended Architecture)



Preparing the Register Factory for Checking – Rule Definition

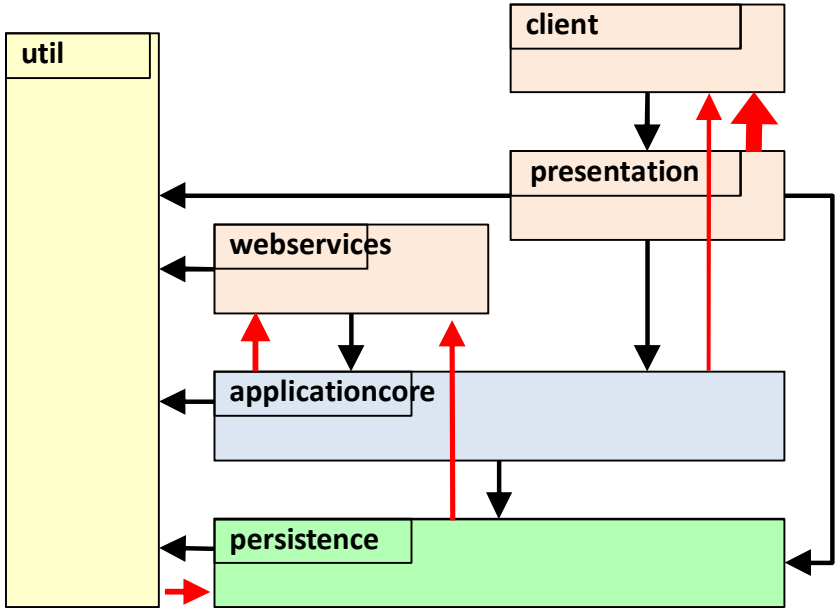
- We derived formalized architecture rules from informal descriptions and interviews

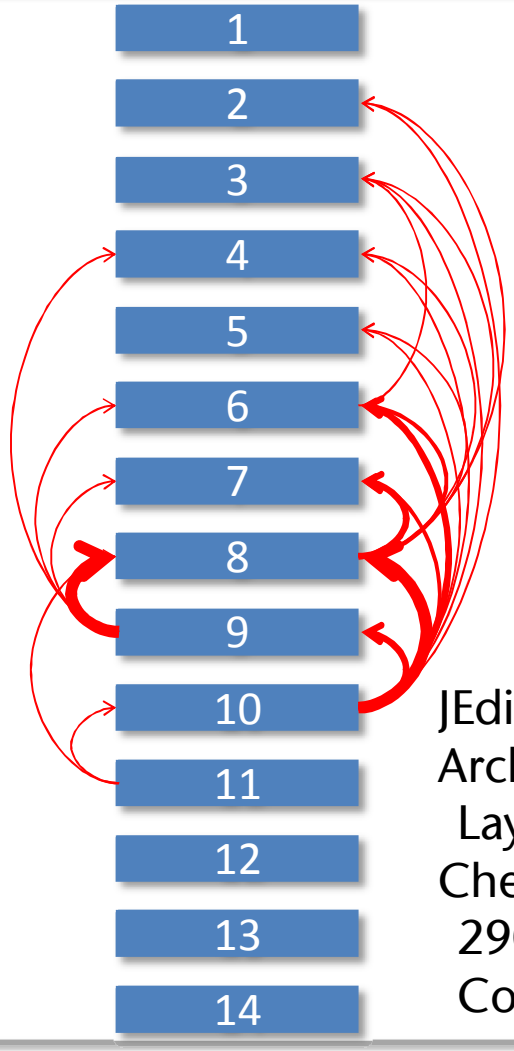



```
(=>
   (and
      (isInternallyUsableOnly ?comp ?innerType)
      (isNotPartOfComponent   ?comp ?type)
      (existsUseDep           ?type ?innerType)
   )
   (trespassesCompFacade ?comp ?type ?innerType)
)
```

Case Studies – Layered Architectures

Industrial Case Study
Architecture Aspects: Layers, not documented, identified by interviews
Checked Artefacts: 130 KLOC Java Code, reverse engineered UML design models

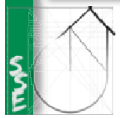




JEdit Case Study
Architecture Aspects: Layers
Checked Artefacts: 290 KLOC Java Code

Discussion and Future Work

- Approach is flexible as different case studies show
- Architectural rules are formulated in terms of the ontology, hence independent of checked meta models
- Its performance allows conformance checking as dedicated interactive job (not JIT) or as part of automatic build processes.
- Future Work includes
  - More intuitive definition of rules (composition of rules, graphically, catalogs of rules for patterns, etc.)
  - From detecting erosion towards repairing erosion: how to restore architecture conformance in complex eroded systems.



Thank you for your attention!

Are there any questions