Towards Compliance-driven Models, Languages, and Architectures for Service-oriented computing

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Outline

- Introduction
- Problems in Compliance
- Proposed approach based on architectural views
- Conclusion and Future Work


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Targeted Field: SOC and SOA

- *Service-oriented computing (SOC)*
  - emerging computing paradigm
  - utilizes services as the basic constructs to support the rapid and easy composition of distributed applications
- *Service-Oriented Architecture (SOA)*
  - Architectural style in the field of Service-Oriented Computing
  - The service composition layer is typically on the top of a SOA
  - This layer often provides a process engine (or workflow engine) which invokes the SOA services to realize individual activities in the process
  - The main goal of such *process-driven SOAs* is to increase the productivity, efficiency, and flexibility of an organization via process management

COMPAS - Overview

- COMPAS addresses a major shortcoming in today's approach to design SOAs:
  - Throughout the architecture various compliance concerns must be considered
  - Examples*:*
    - Service composition policies, Service deployment policies,
    - Information sharing/exchange policies, Security policies, QoS policies,
    - Business policies, Jurisdictional policies, Preference rules Intellectual property and licenses
- So far, the SOA approach does not provide any clear technological strategy or concept of how to realize, enforce, or validate them

Compliance Concerns: Examples

- Service composition policies
  - e.g., use of data for a certain case only
- Service deployment policies
  - e.g., geographic restrictions for service instances
- Information sharing/exchange policies
  - e.g., request/response use specific message type
- Security policies
- QoS policies
- Business policies
- Jurisdictional policies
- Preference rules
- Intellectual property and licenses

Compliance Concerns Categories

- *Technical compliance concerns that must be validated at design time*
  e.g., compliance to composition policies

- *Technical compliance concerns that must be validated at runtime*
  e.g., compliance to QoS policies

- *Domain-oriented compliance concerns that must be validated at design time and runtime*
  - This category is the most complex one, as it is build on top of the two technical categories
  - *e.g., compliance to preference rules, to licenses, etc.*

Problem in Detail

- A number of approaches, such as business rules or composition concepts for services, have been proposed
- None of these approaches offers a unified approach with which all kinds of compliance rules can be tackled
- Compliance rules are often pervasive throughout the SOA
- They must be considered in all components of the SOA
- They must be considered at different development times, including analysis time, design time, and runtime

Current Practice for Dealing with Compliance

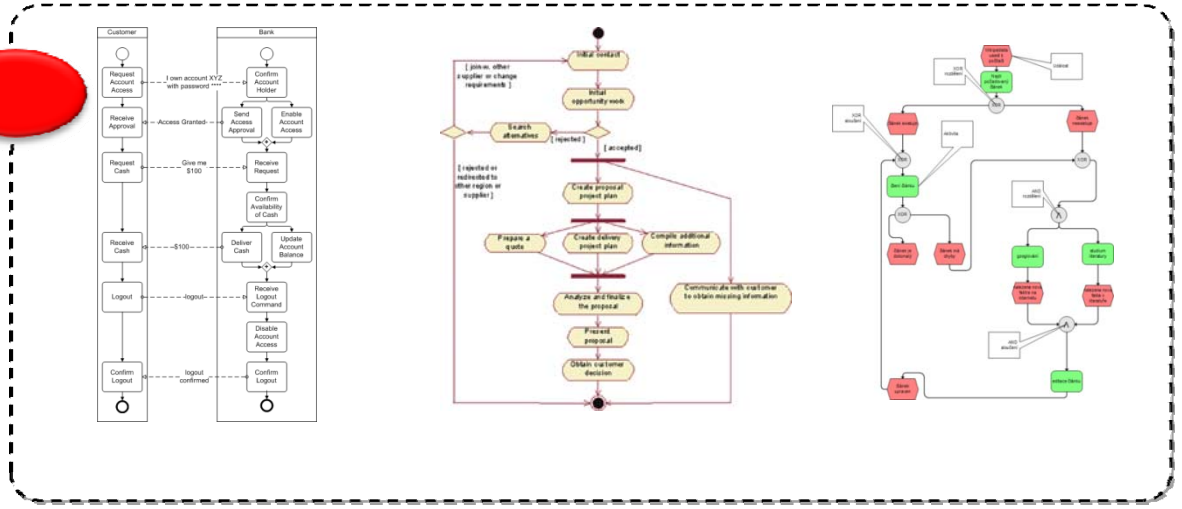
- In many cases, business compliance today is reached on a per-case basis
- Companies do not have a generic strategy for business compliance
- Instead they use ad hoc, hand-crafted solutions for specific rules to which they must comply

Issues with the Current Practice

- Systems are
  - hard to maintain
  - hard to evolve or change
  - hard to reuse
  - hard to understand
- It is difficult to ensure guaranteed compliance to a given set of rules and regulations
- It is difficult to keep up with constant changes in regulations and laws

Process-driven development scenarios

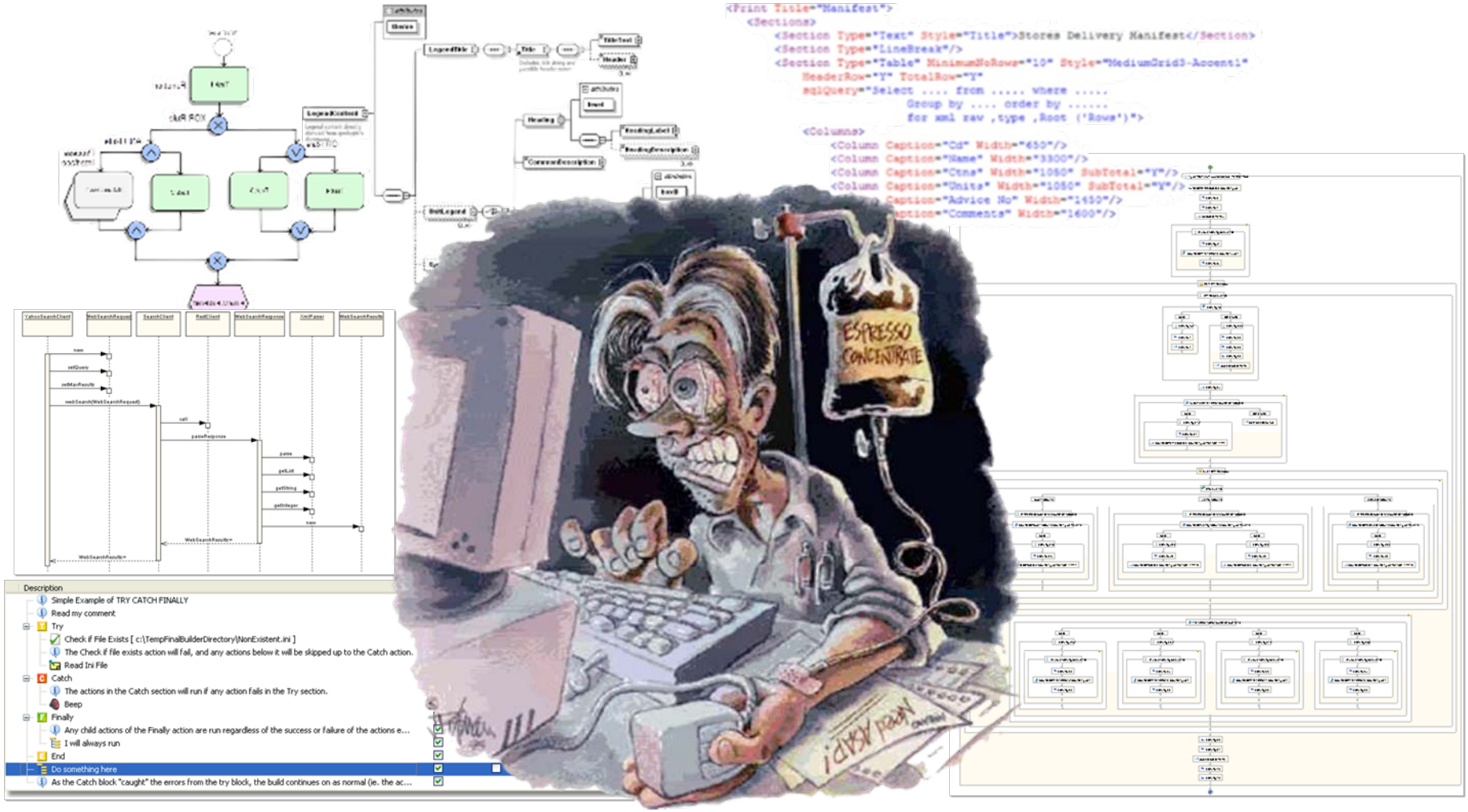
Business/domain experts



IT experts

```
142         byte[] result = XmlUtil.transformToBytes(node, "utf-8", true);
143         for (int ii = 0; ii < expResult.length; ii++) {
144             assertTrue(expResult[ii] == result[ii]);
145         }
146
147         expResult = ("<?xml version=\"1.0\" encoding=\"utf-8\"?>\r\n" +
148                 "<helloWorld xmlns=\"urn:Foo\"> Hello World!!!\r\n" +
149                 "  <string>input0</string>\r\n" +
150                 "  <byte>a</byte>\r\n" +
151                 "  <short>5</short>\r\n" +
152                 "  <int>12345</int>\r\n" +
153                 "  <long>12345</long>\r\n" +
154                 "  <float>2.22</float>\r\n" +
155                 "</helloWorld>\r\n").getBytes();
156         result = XmlUtil.transformToBytes(node, "utf-8", false);
157         for (int ii = 0; ii < expResult.length; ii++) {
158             assertTrue(expResult[ii] == result[ii]);
159         }
160
161         result = XmlUtil.transformToBytes(node, "utf-8", false, "xml");
162         for (int ii = 0; ii < expResult.length; ii++) {
163             assertTrue(expResult[ii] == result[ii]);
164         }
165
166         expResult = ("Hello World!!!").getBytes();
167         node = document.createTextNode("Hello World!!!");
168
169         result = XmlUtil.transformToBytes(node, "utf-8", false, "text");
170         for (int ii = 0; ii < expResult.length; ii++) {
171             assertTrue(expResult[ii] == result[ii]);
172         }
173
174         System.out.println("Successfully tested transformToBytes");
175     }
```

Process-driven development scenarios



Developer's nightmare – numerous tangled process concerns

Motivation: interoperability and reusability of processes

- Why process description (re)use is difficult
  - *The integration of many tangled aspects hinders understandability, modularity*
    - the control flow, service interactions, message and message types, fault handling, transactions, compliances, process engine configurations, etc.
  - *Stakeholders have different point of views, abstraction levels, skill sets, needs, etc.*
    - Business or domain experts
    - IT experts: developers, administrators

Existing solutions so far?

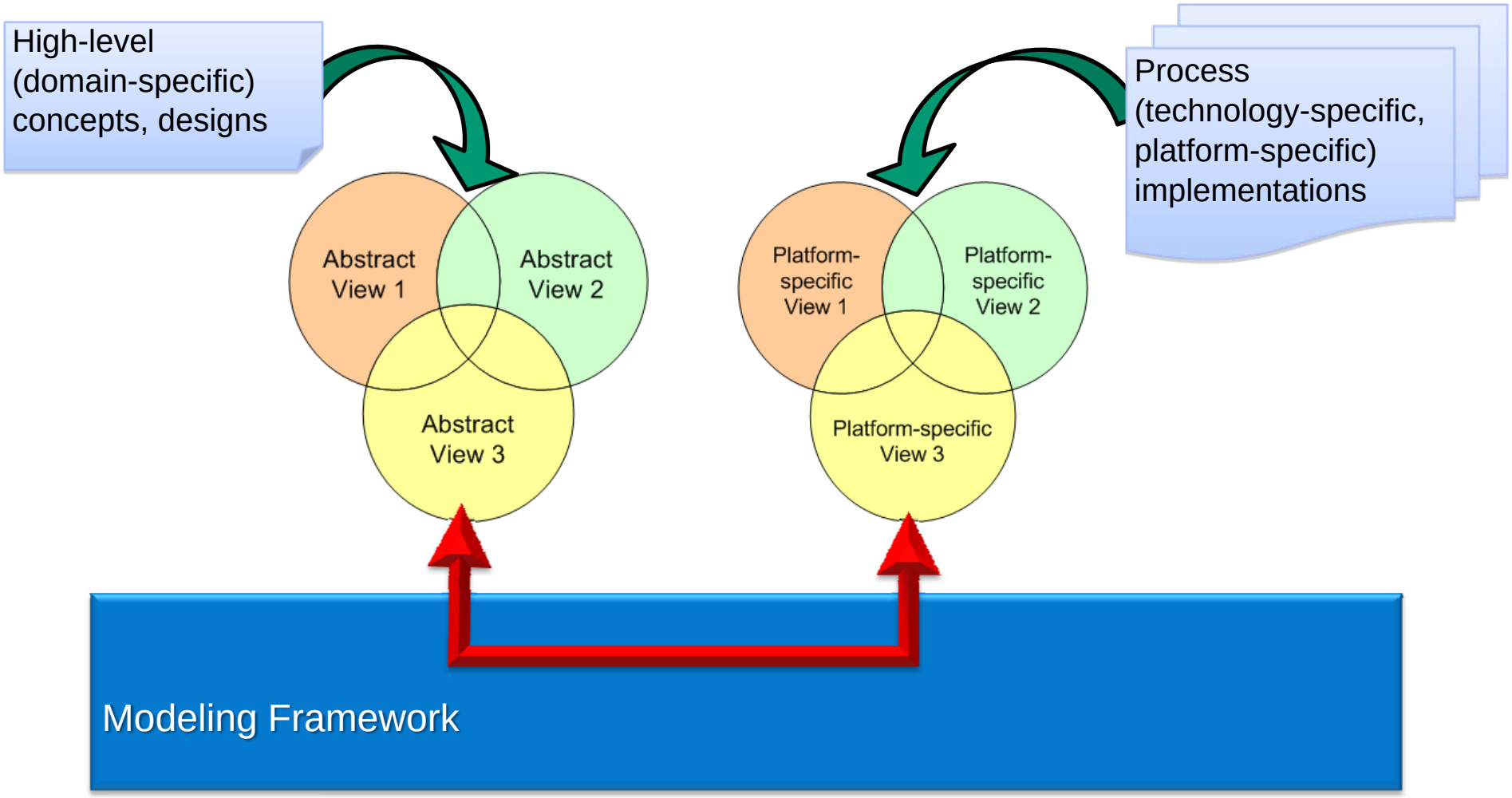
- Manually done by ”**copy and paste**“
  - Time-consuming and error-prone
  - Only IT developers are able to do “copy and paste“
  - Hinders scalability and agility
- Language transformation-based approaches
  - E.g., BPMN/EPC/UML Activity diagrams to BPEL/WSDL, and vice versa.

- **Workflow** mining
  - Extracts (only) workflows from applications

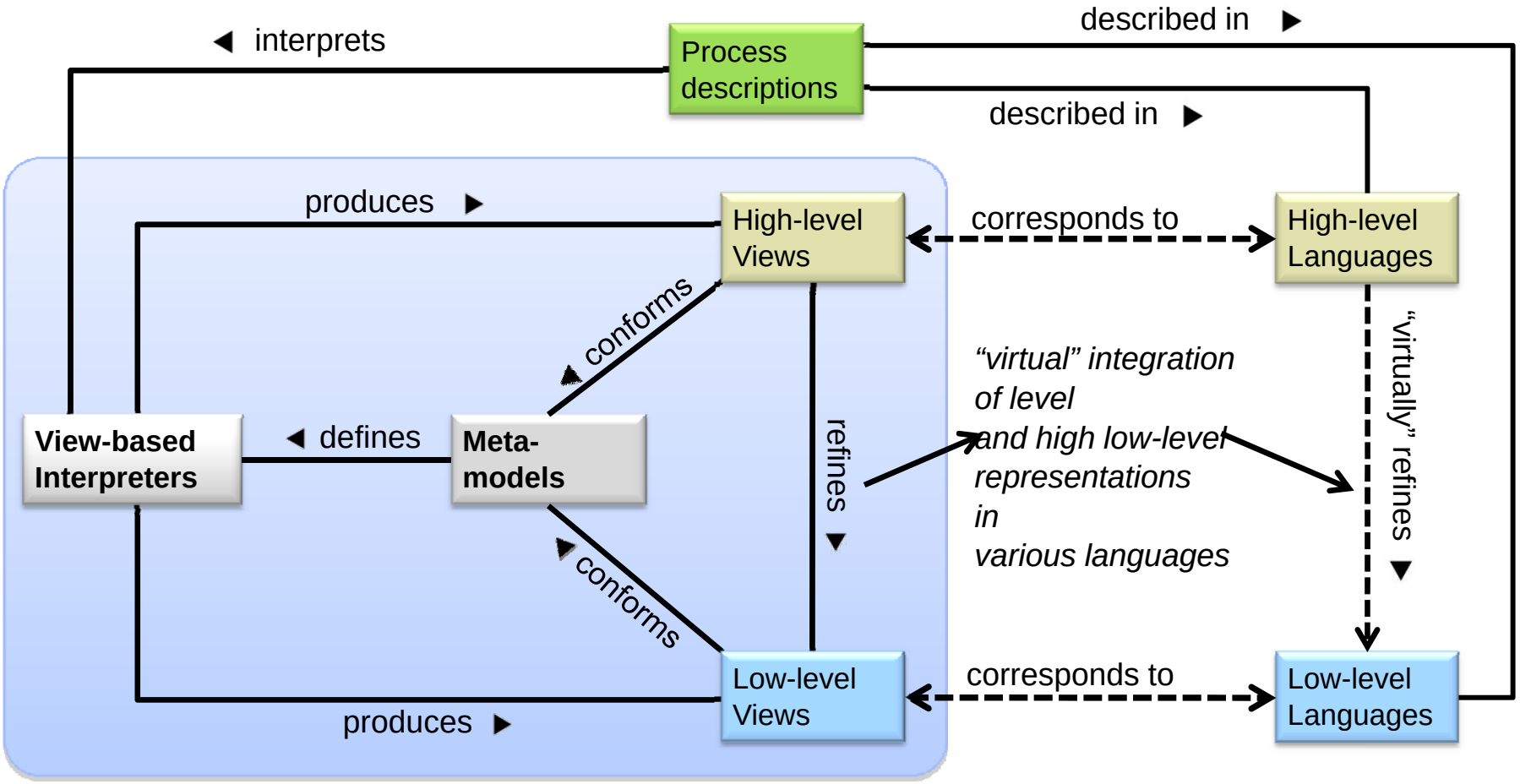
Proposed solution: View-based Model-driven Engineering

- Separation of concerns principle
  - A realization: concept of **architectural views**
- Model-driven engineering
  - **(semi)-formalization of process fragments** to enhance modularity, reusability, etc.
  - separation of abstraction levels by tailored views to enhance adaptability, understandability
- **View-based reverse engineering**
  - extracts (semi)-formalized views

Proposed integration solution

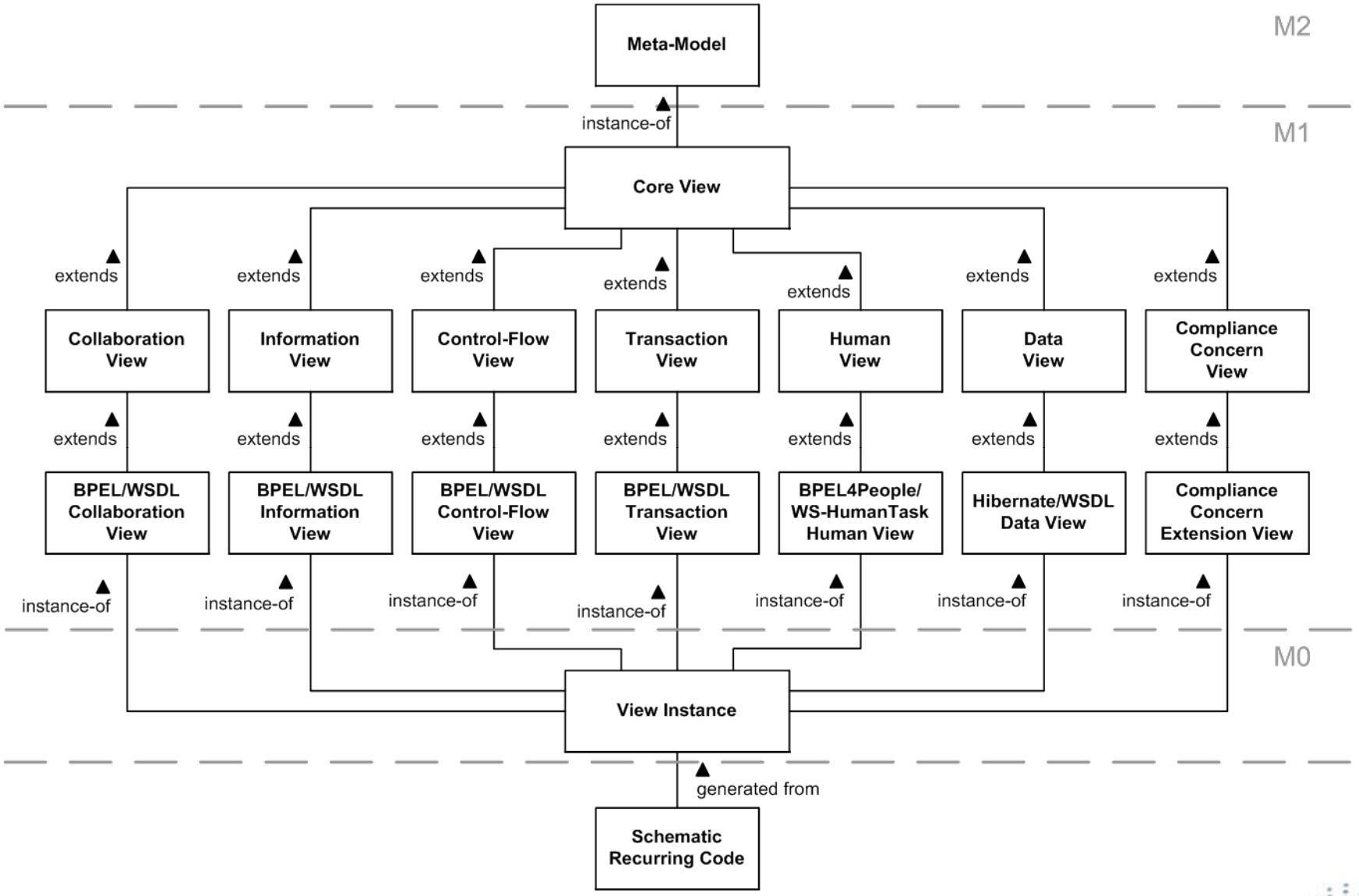


View-based integration architecture

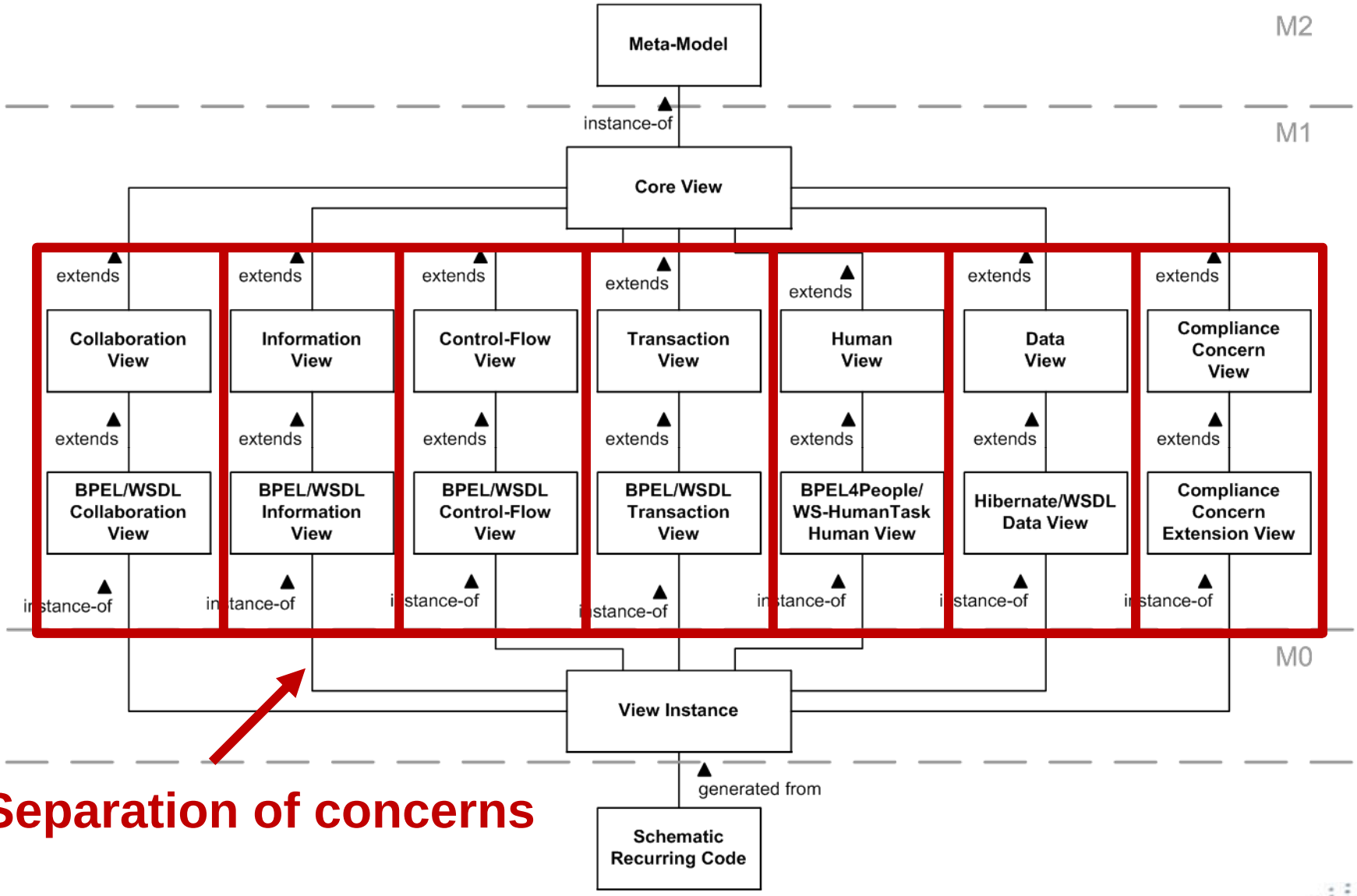


View-based Modeling Framework

View-based Modeling Framework (VbMF)

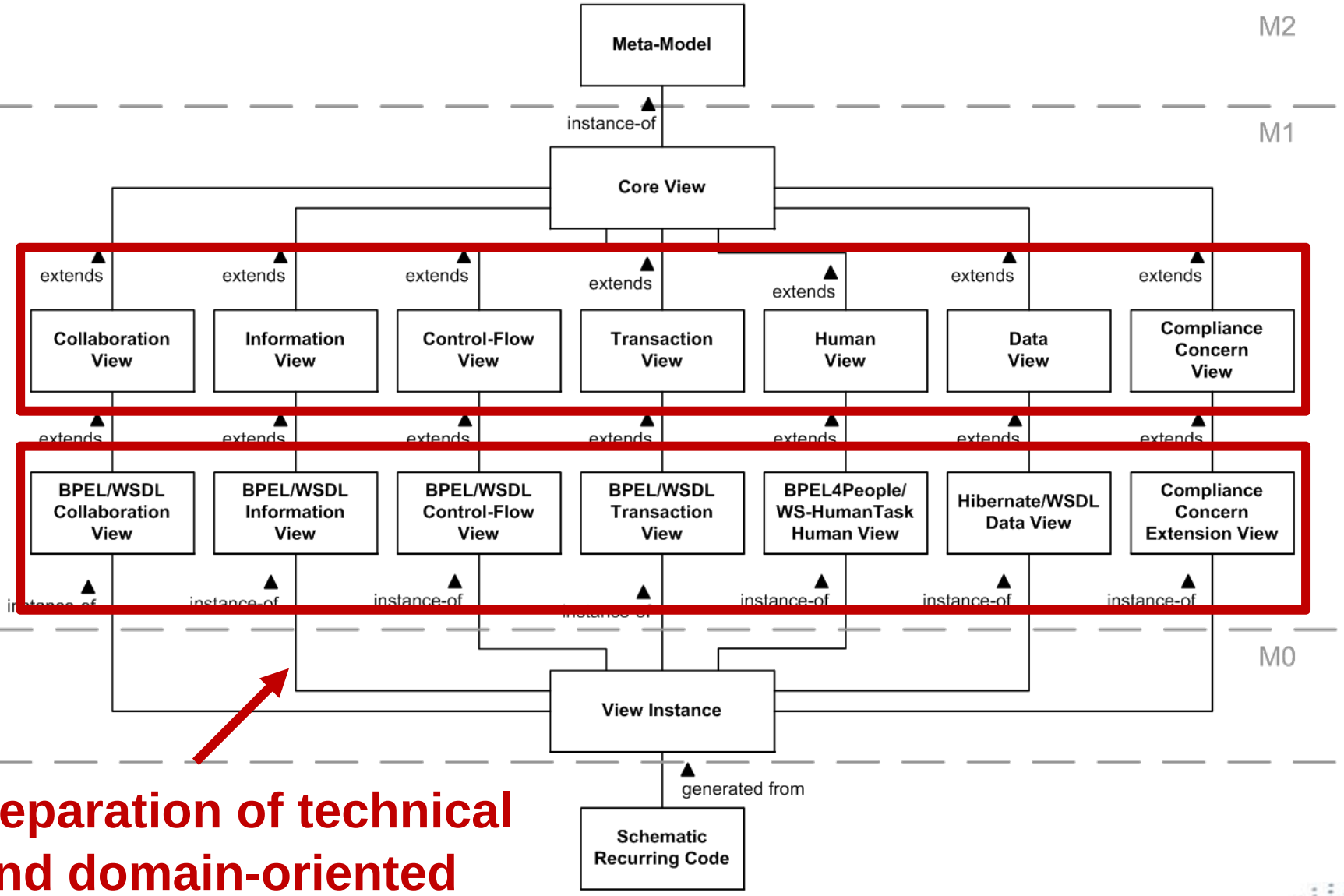


View-based Modeling Framework (VbMF)



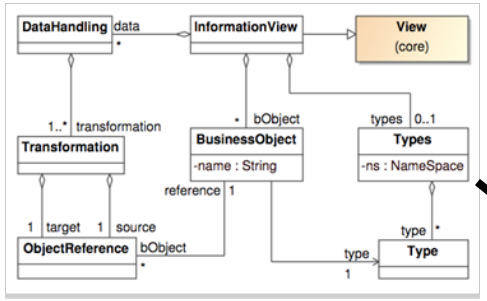
Separation of concerns

View-based Modeling Framework (VbMF)



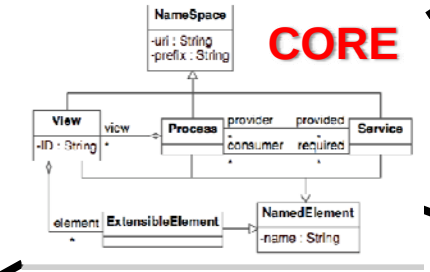
Separation of technical and domain-oriented views

View-based Modeling Framework (VbMF)

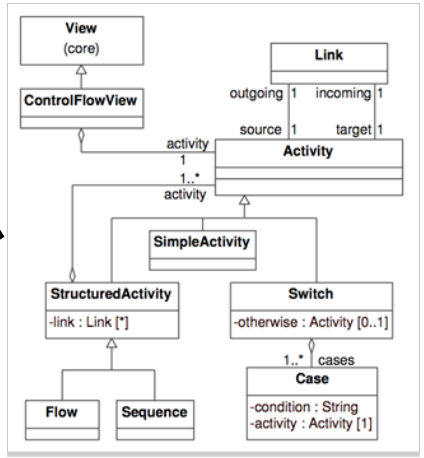


Information View meta-model

extends

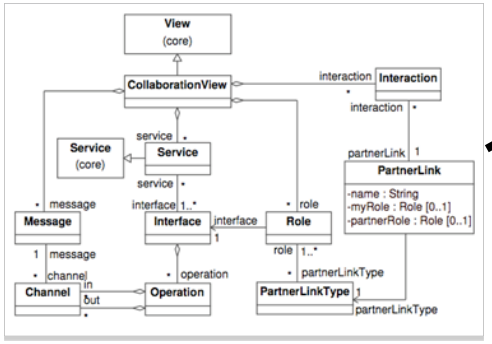


extends



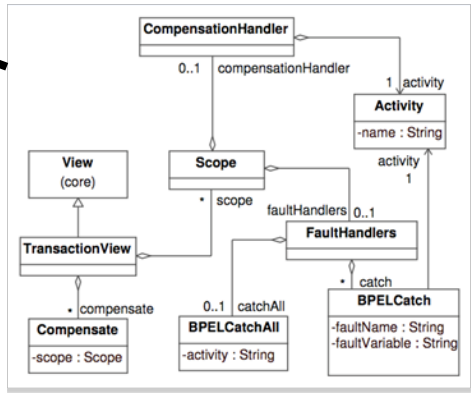
Control-flow View meta-model

extends



Collaboration View meta-model

extends



Transaction View meta-model

Horizontal extensibility of VbMF

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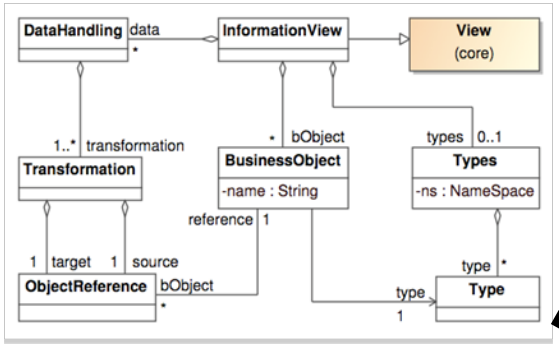
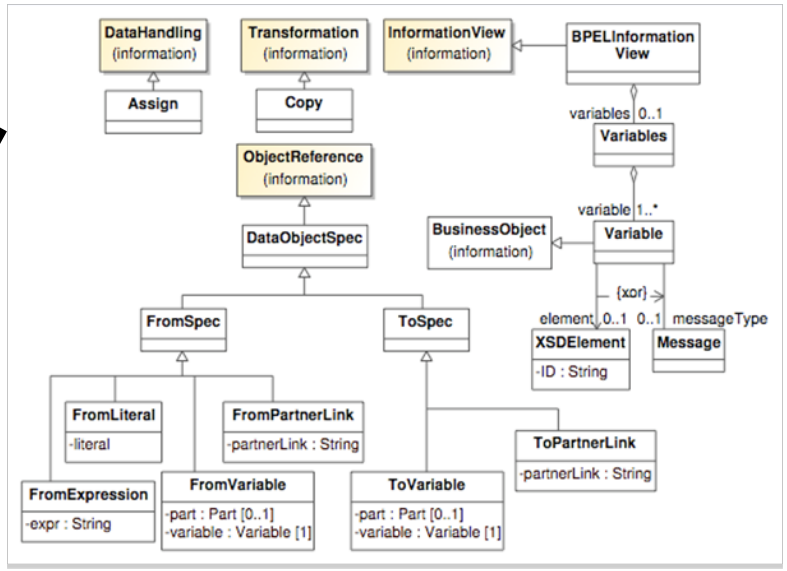
View-based Modeling Framework (VbMF)



Information View meta-model

extends

An extension of the Information View meta-model

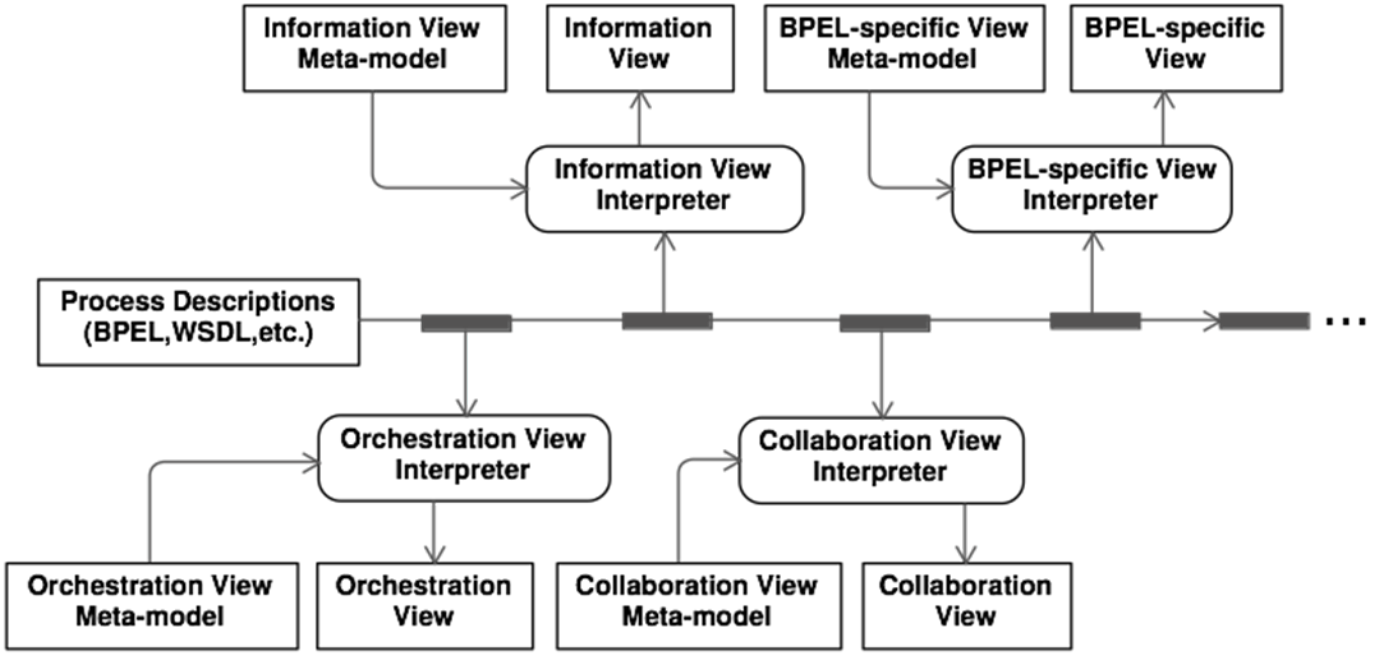


High-level abstraction

Lower-level abstraction

Vertical extensibility of VbMF

View-based Interpreters



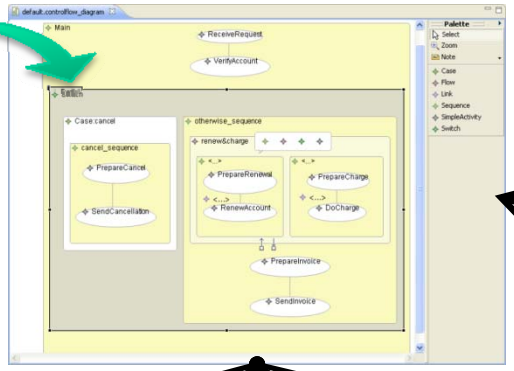
Chain of Responsibility and *Partial Interpreter Pattern* - General Approach For View Extraction

The overall Tool chain

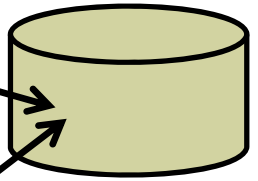
- Design
  - Modeling of Views within the VbMF (EMF/GMF-Editor)
- Transformation
  - Invocation of the Code Generation (oAW-Workflow)
- Validation
  - Semantic validation/optimization of a process
- Deployment
  - Prepare and deploy process on a BPEL engine
- Execution
  - Fire & Forget a long-running process

How views are reused?

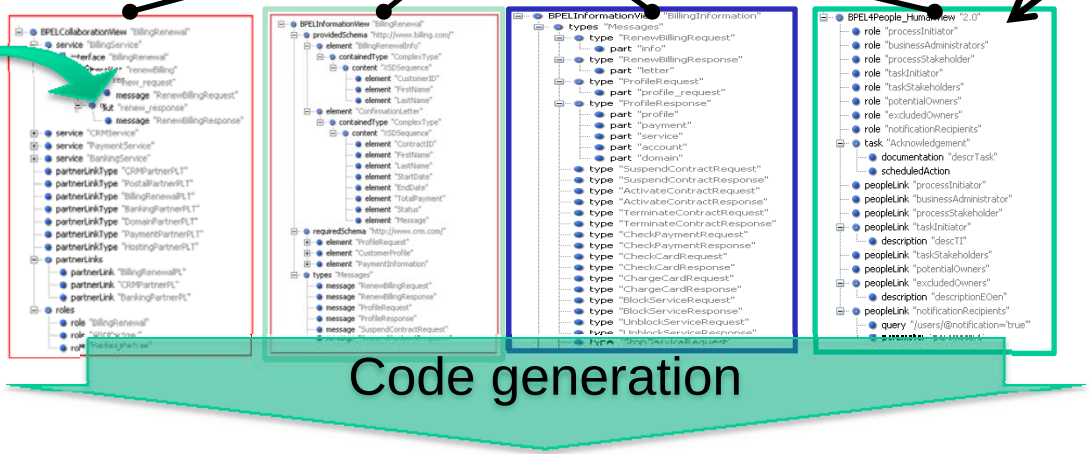
Business, domain experts



High-level, problem-oriented views



View-based repository



Low-level, technology speficic Views

IT experts

executable code, configurations

Current Work

- Collaborative Model-Driven Development
  - Lightweight Collaborative Model-Driven Environment
  - Correlation of Process Stakeholders & MDD Artefacts
  - Model Repository
- Distributed Process Monitor
  - for Debugging, Logging, Monitoring, etc.
  - Publishers = Components
  - Broker Architecture
  - Distributed Subscribers

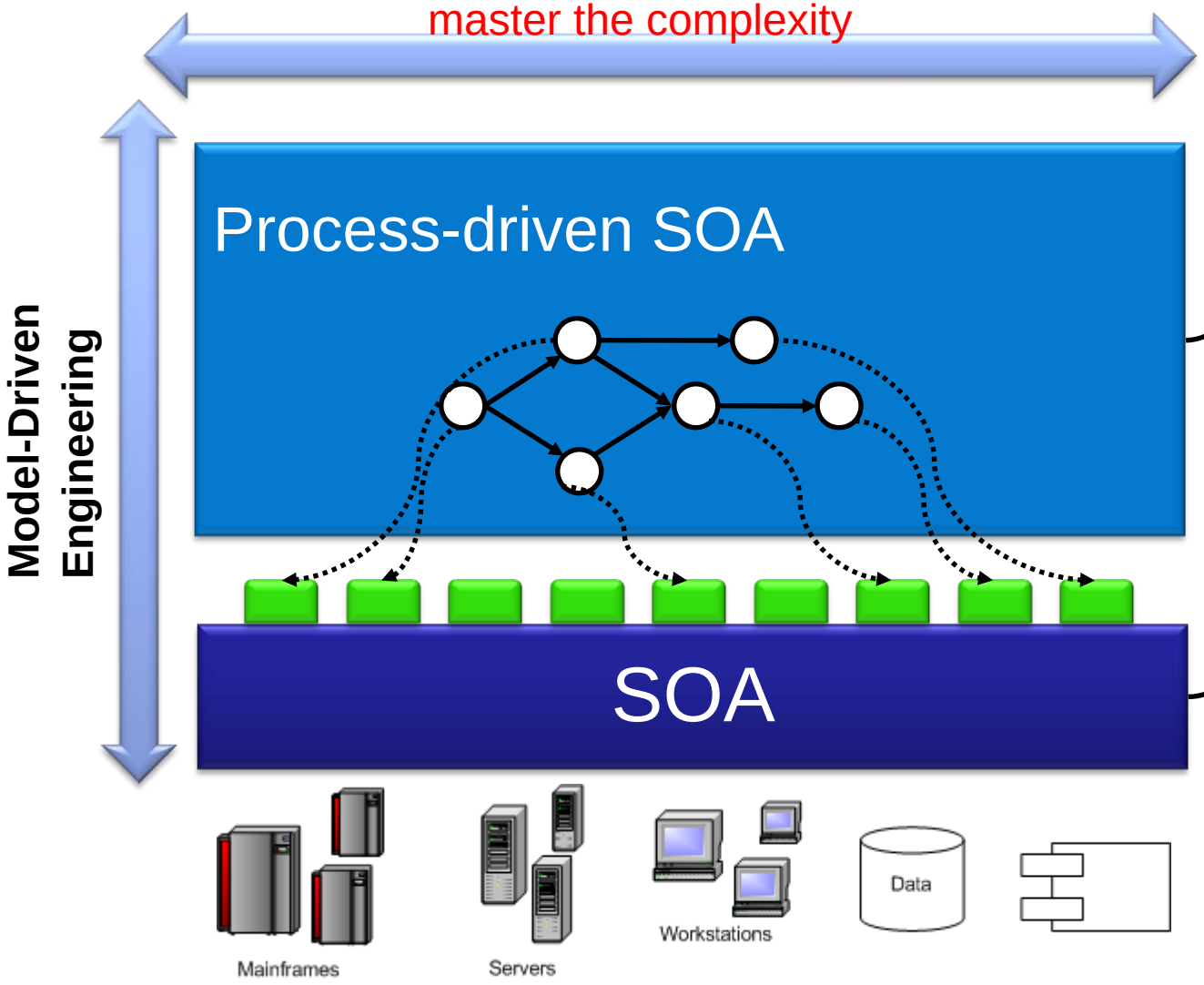
Current Work

- Dependency management
  - Traceability
  - Change impact analysis
  - Change propagation
- Collaborative view repository
  - View-based, model-driven repository

Summary of our approach

VbMF

Separation of Concerns
(e.g., *architectural views*) to
master the complexity



provides an efficient method for integrating business functionality

reconciles the heterogeneous nature of software systems

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Thanks for your attention!

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