The SENSORIA Development Environment

CASE Tool for SOA Development

SENSORIA EU FP6 project
19 partners from 7 countries
4 years, 4 M EUR

Coordinator: Prof. Dr. Martin Wirsing, Ludwig-Maximilians-Universität München, Germany
Università di Trento | University of Leicester | Warsaw University | TU Denmark at Lyngby | Università di Pisa
Università di Firenze | Università di Bologna | ISTI Pisa | Universidade de Lisboa | University of Edinburgh
ATX Software | SATelecom Italia Lab | Imperial College London | Cirquent GnbH (FAST GmbH) | Budapest University of Technology and Economics |S&N AG | University College London | Politecnico di Milano

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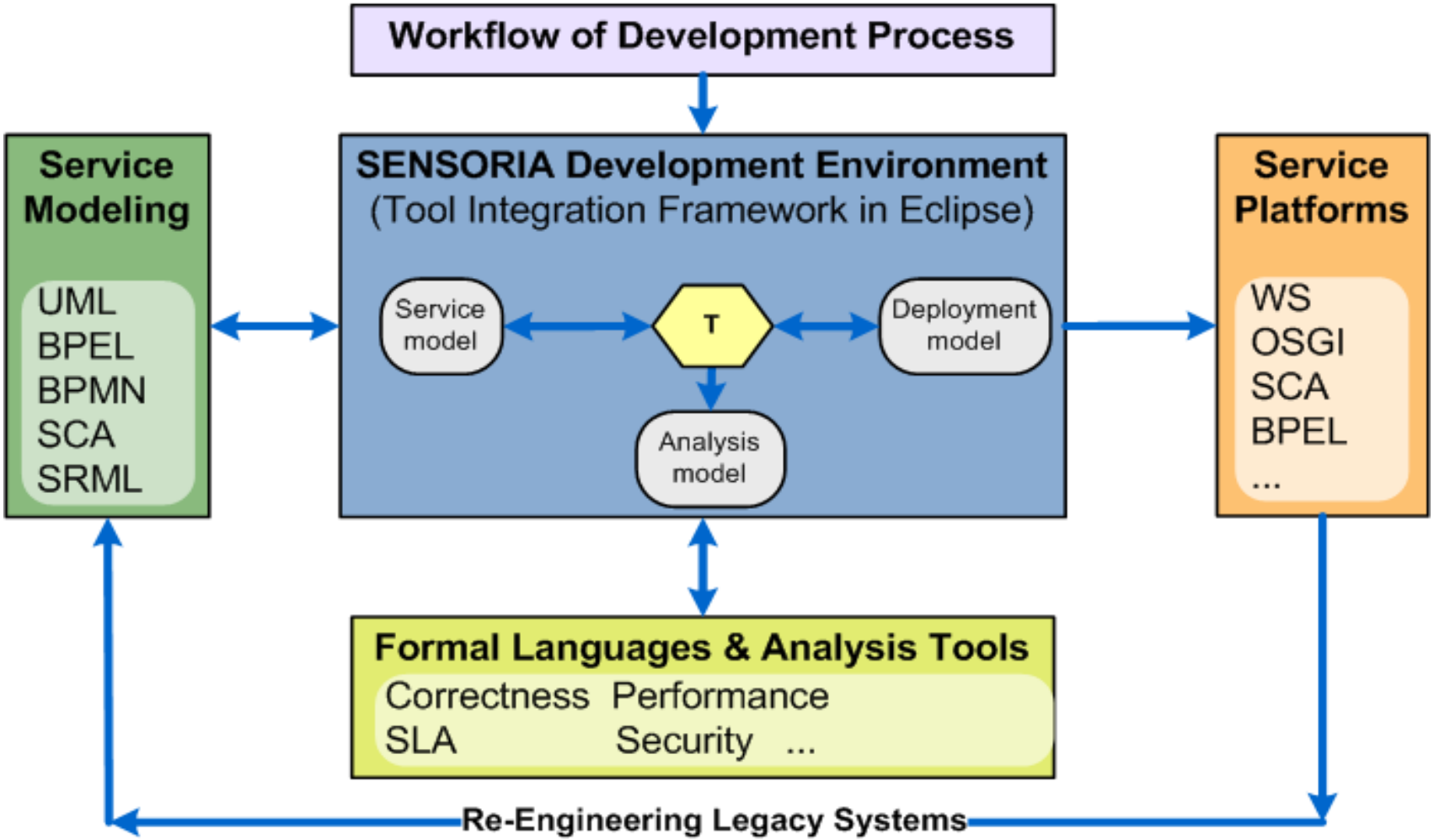
Context

- Service-Oriented Computing
  - Create new services
  - By composing existing functionality
  - With „Loosely-coupled" interaction
  - >Resilient to changing (business) environment
- Envisaged market impact
  - **Time-to-market of service integration** can be reduced
  - Increased **quality of service**
    (security, response time, throughput, availability….)
  - Portability to existing platforms to **maintain profitable services**
- Challenges
  - **Specification and querying** of services?
  - **Correctness and consistency** of service composition?
  - Continuous operation in **changing environment** (service outages)?
  - Design for **justifiable SLA-compliance** (security, performance)?

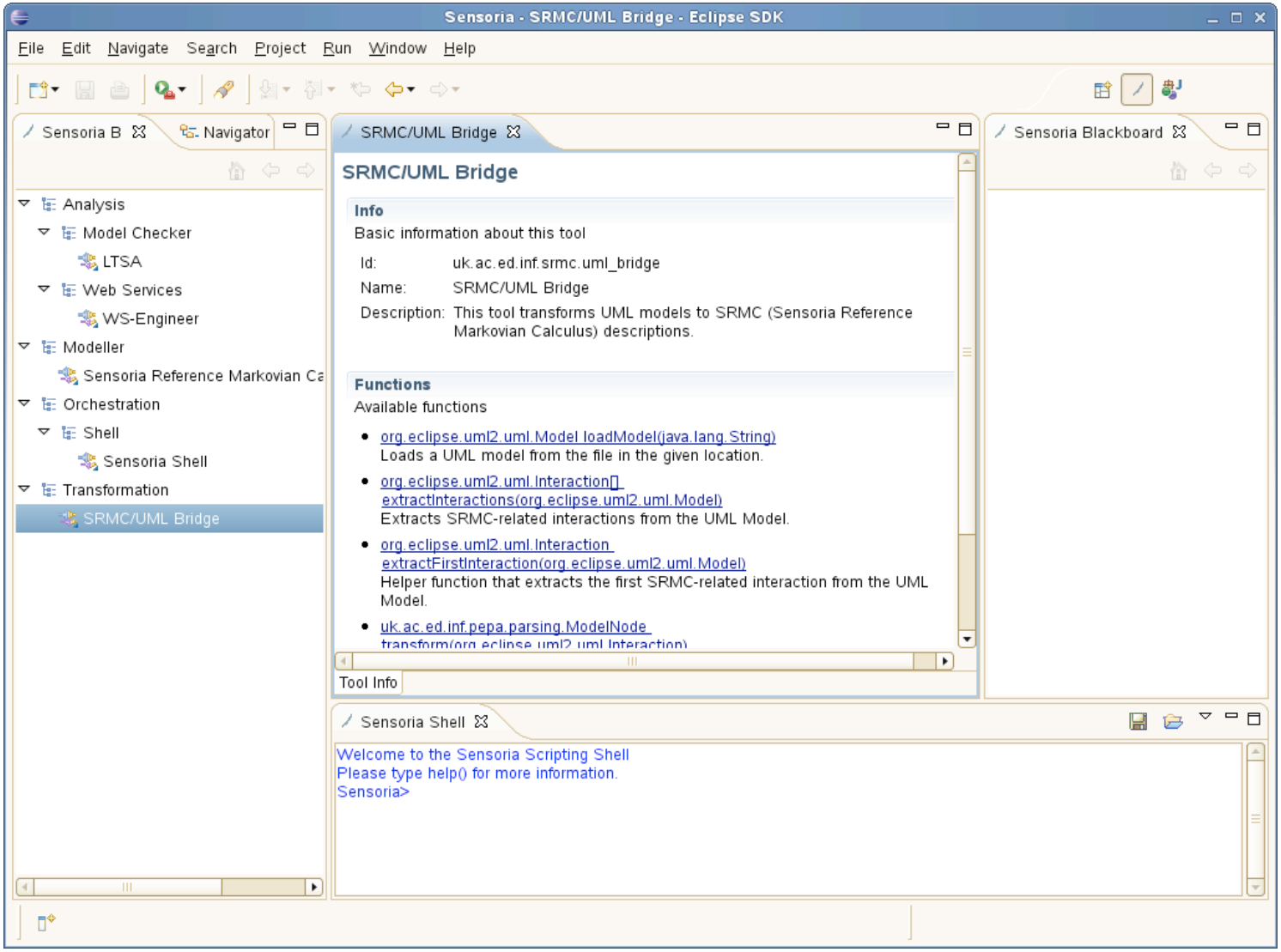
The SENSORIA Approach



The SENSORIA Development Environment (SDE)

- Objective of the SDE
  - Provide a service-oriented platform for tool integration
- Benefits
  - Discover & install SOA development tools
  - Orchestrate & compose tools as services
  - A homogeneous platform for the service-based toolchain
- SDE is based on SOA
  - OSGi for services
  - Eclipse for UI

The SDE UI


Sensoria - SRMC/UML Bridge - Eclipse SDK
File Edit Navigate Search Project Run Window Help
Sensoria B
Navigator
Analysis
Model Checker
LTSA
Web Services
WS-Engineer
Modeller
Sensoria Reference Markovian Ca
Orchestration
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Sensoria Shell
Transformation
SRMC/UML Bridge
SRMC/UML Bridge
SRMC/UML Bridge
Info
Basic information about this tool
Id: uk.ac.ed.inf.srmc.uml_bridge
Name: SRMC/UML Bridge
Description: This tool transforms UML models to SRMC (Sensoria Reference Markovian Calculus) descriptions.
Functions
Available functions
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Tool Info
Sensoria Blackboard
Sensoria Shell
Welcome to the Sensoria Scripting Shell
Please type help() for more information.
Sensoria>

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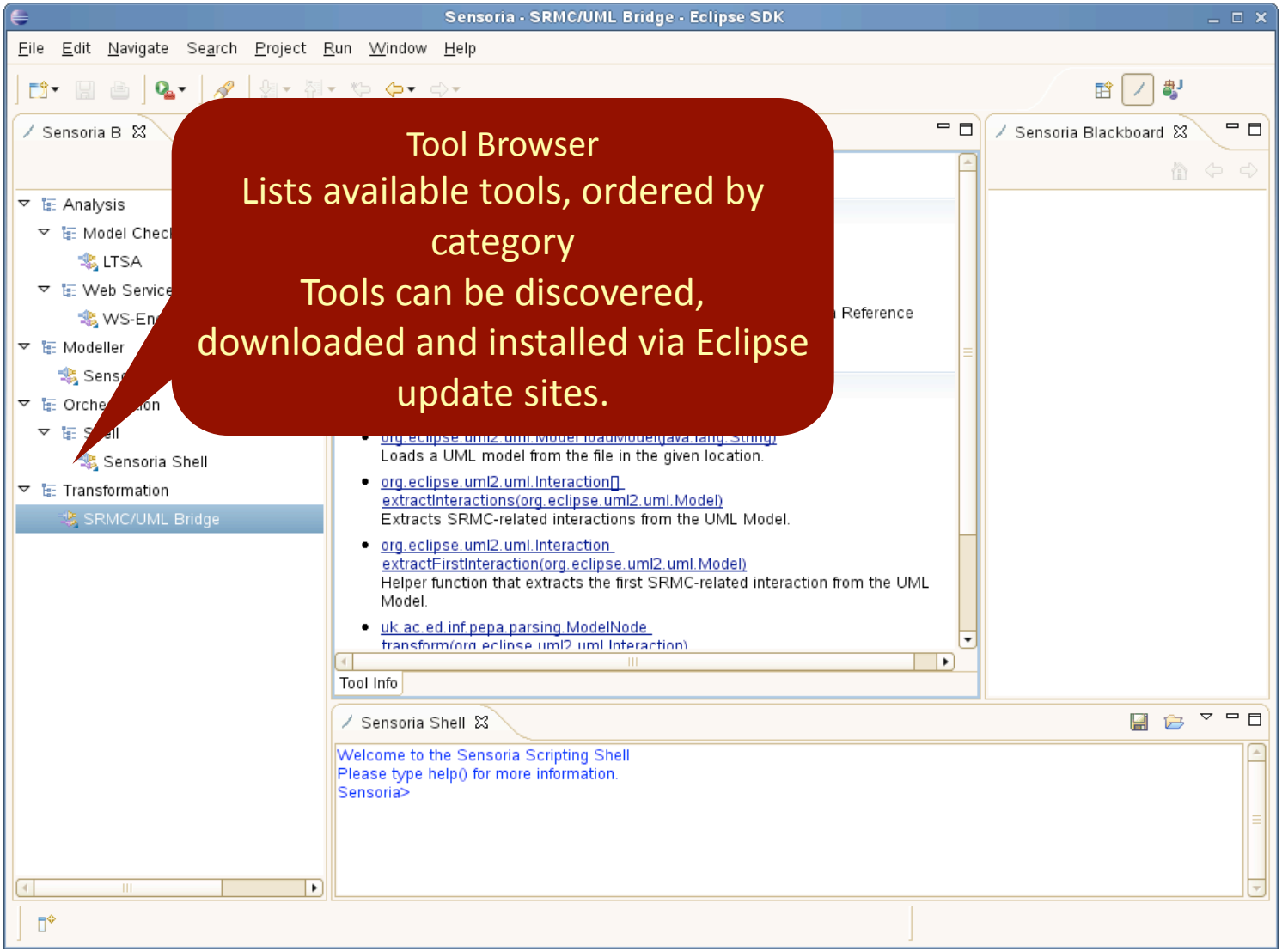
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SRMC/UML Bridge
Tool Browser
Lists available tools, ordered by category
Tools can be discovered, downloaded and installed via Eclipse update sites.
Reference
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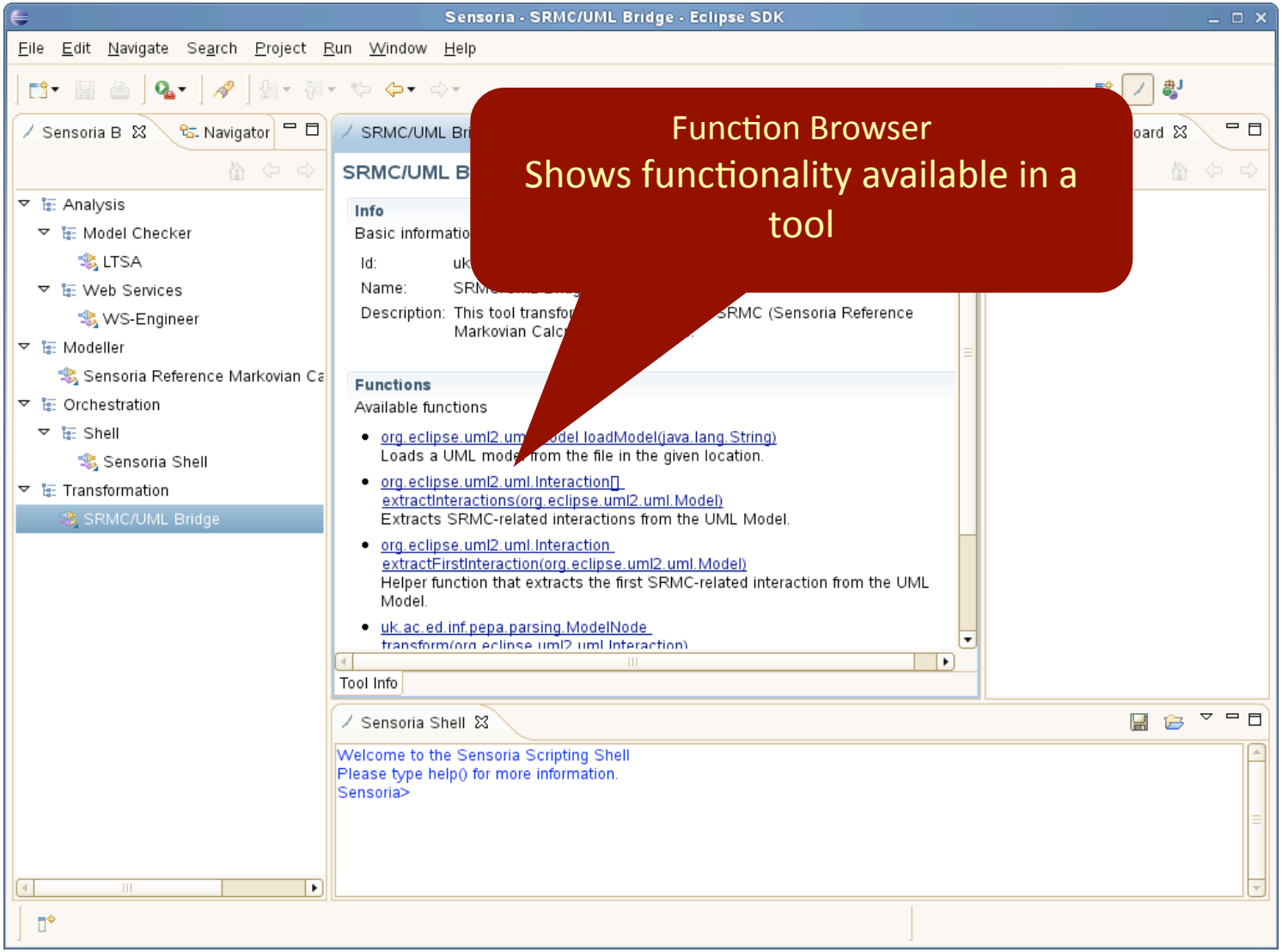
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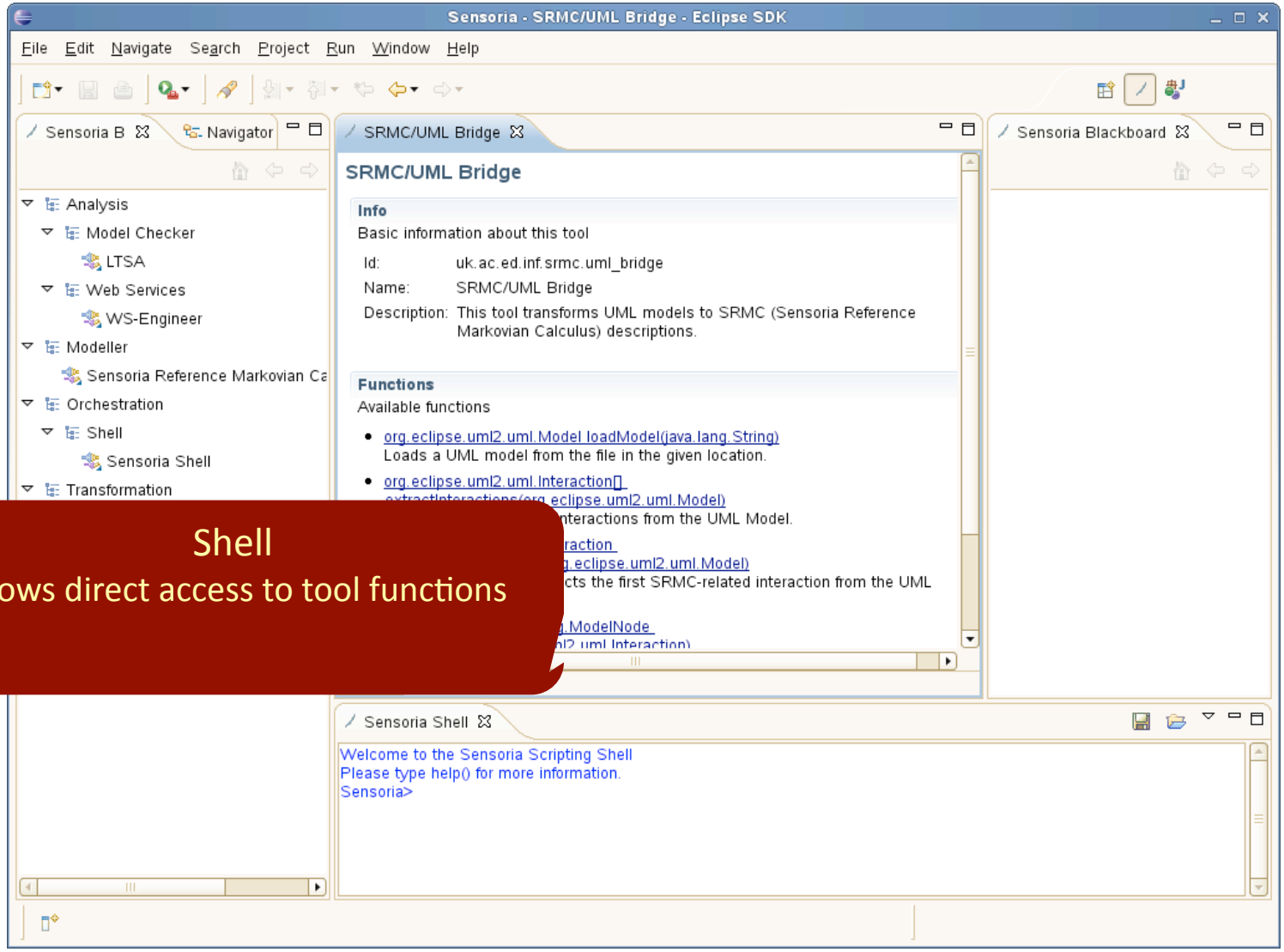
Function Browser
Shows functionality available in a tool

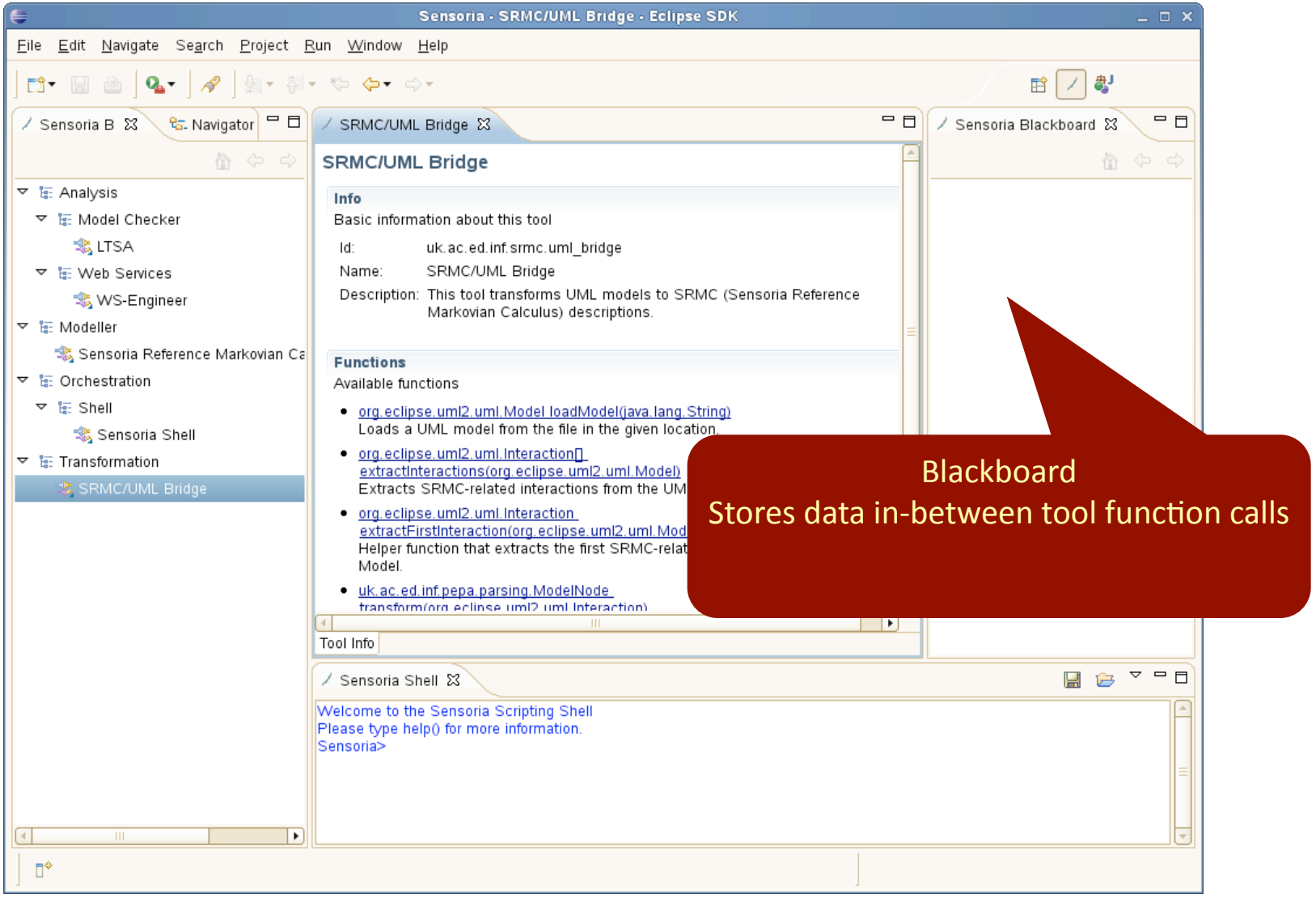
The SDE UI



Shell

Allows direct access to tool functions

The SDE UI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Blackboard
Stores data in-between tool function calls

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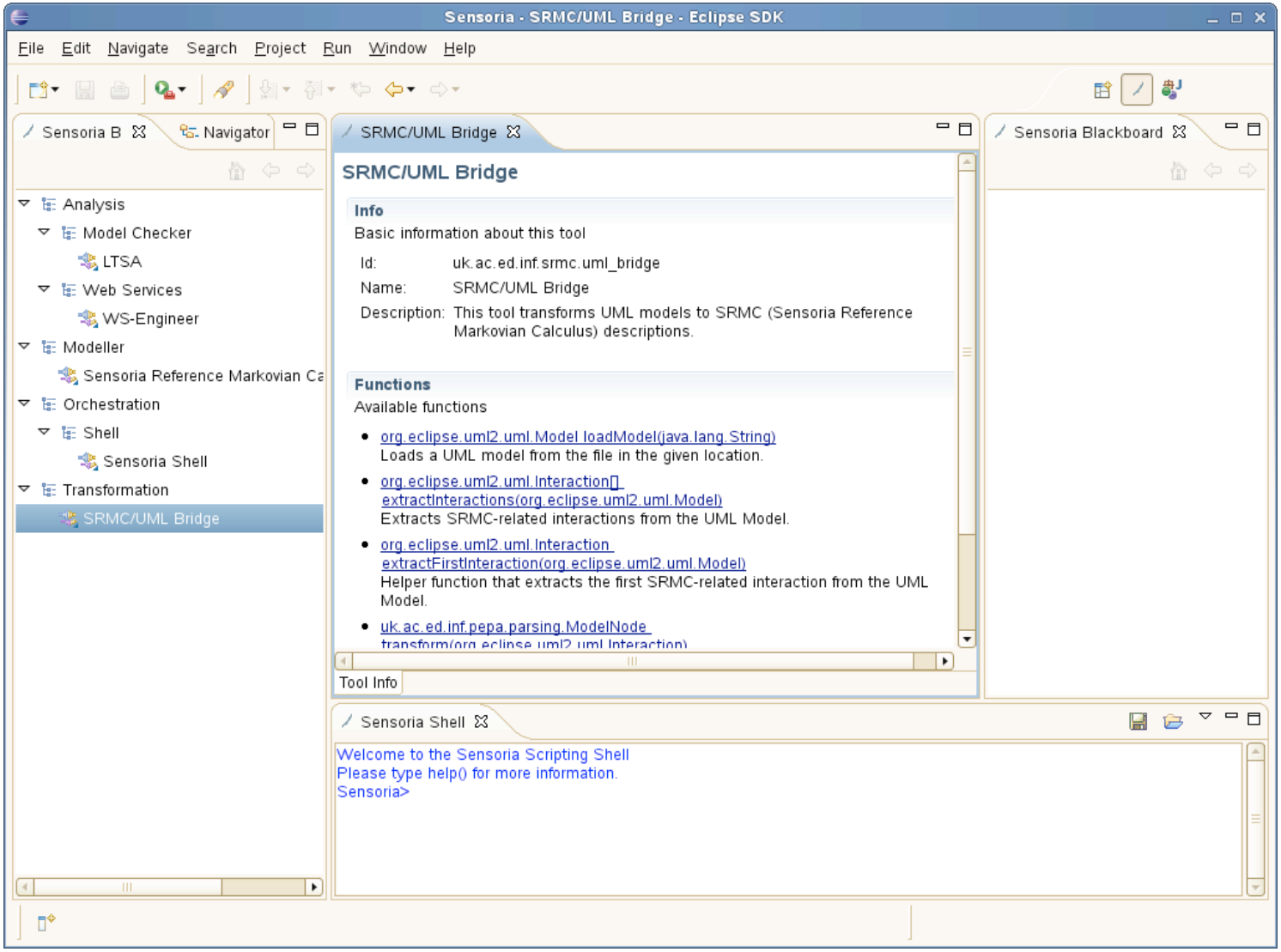
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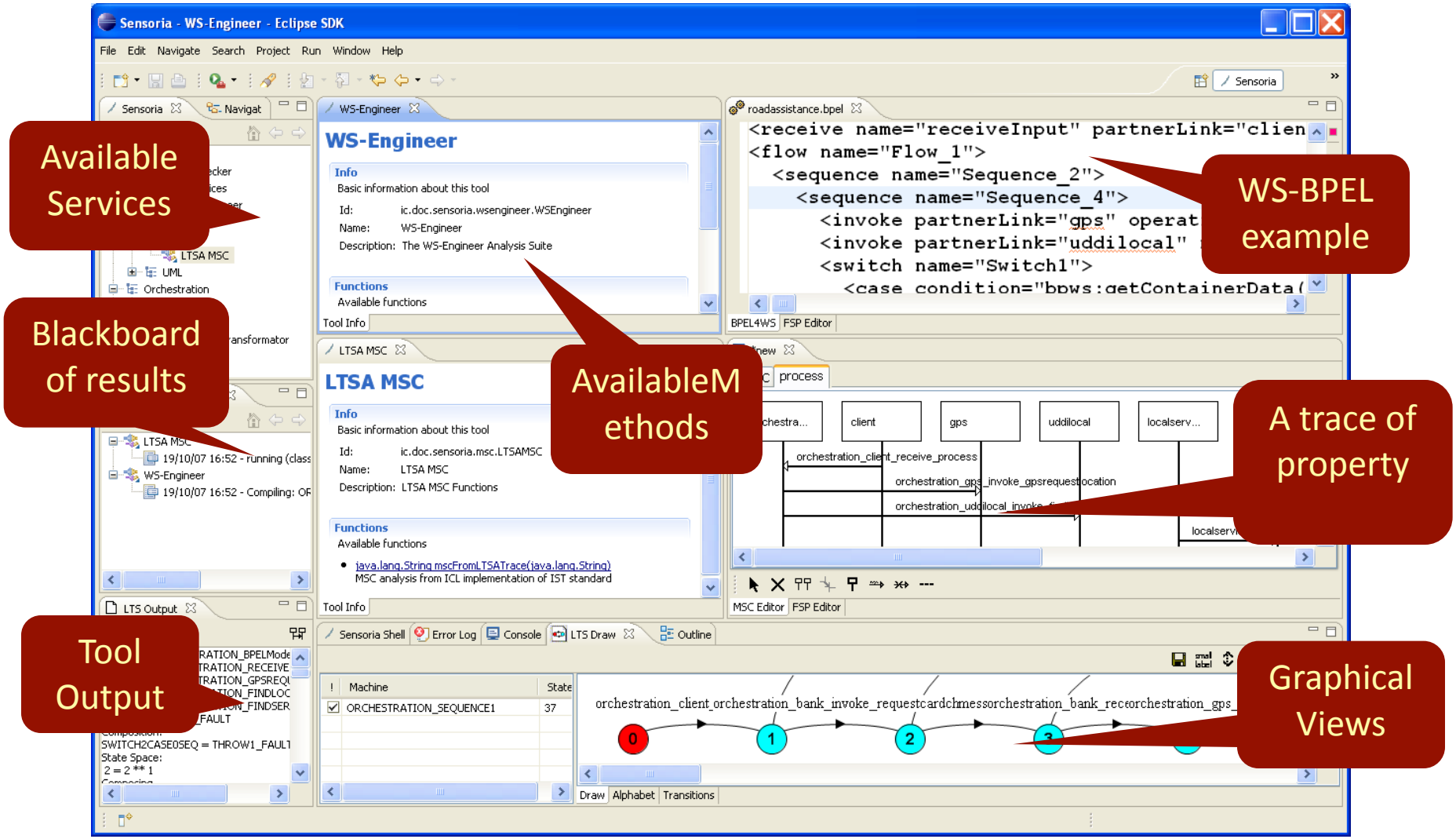
Correctness analysis with WS-Engineer

- **WS-Engineer** supports model-checking WS-BPEL, WS-CDL and WSIF behavioural specifications
  - Properties for analysis of service interaction & behaviour
  - Verification and violation traces
  - Animation for validation
- Automotive Case Study – On Road Assistance Scenario:
  - *Is it true that the credit card of the driver won't be charged if there are no available garages?*
    - Generate formal models of service orchestrations
    - Specify a property for verification
      - e.g. "`property service.orderGarage→throw_fault→bank.revokeCharge`"
    - Check model for violation traces of this property

WS-Engineer at a glance

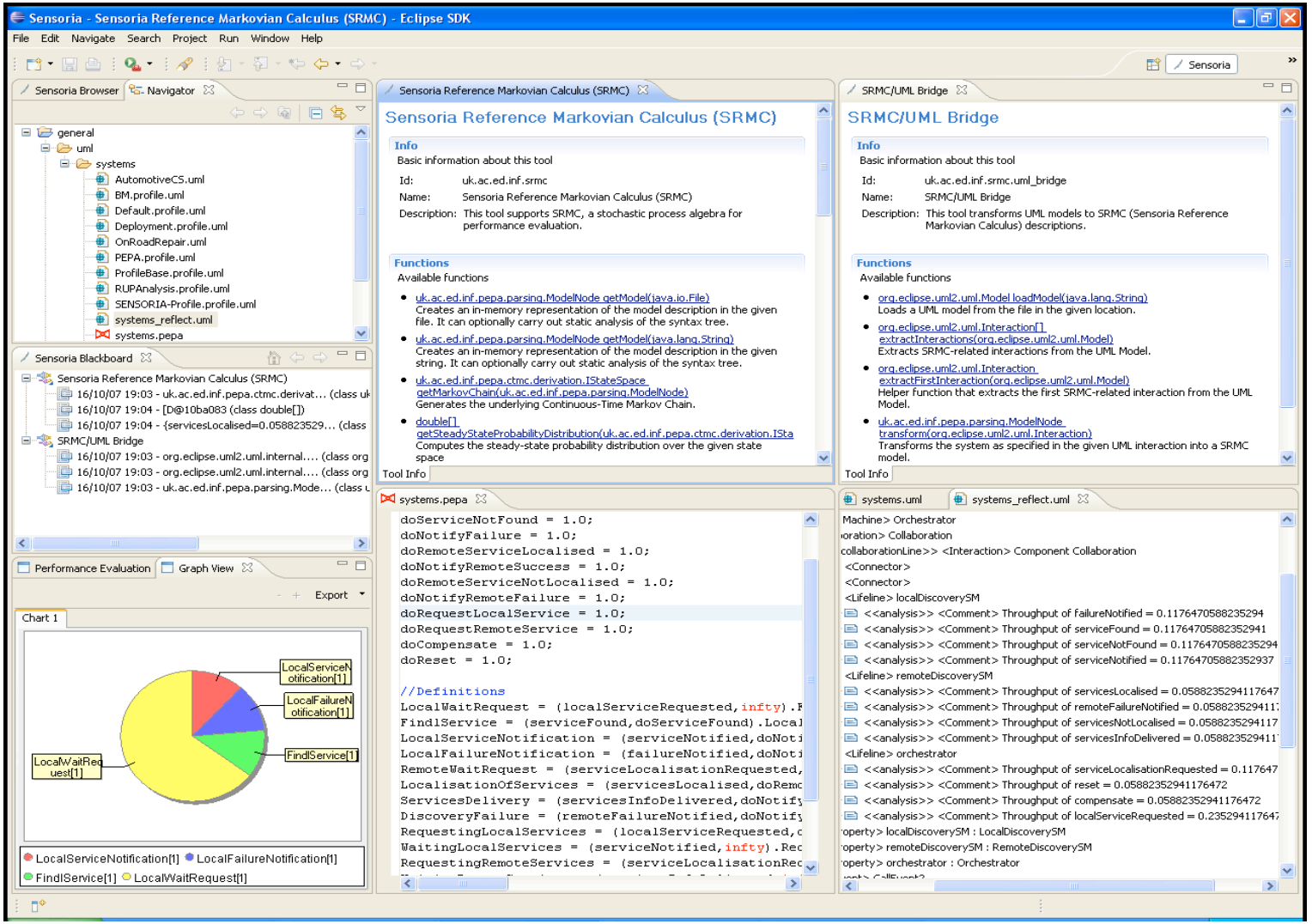


SENSORIA Development Environment for SOA

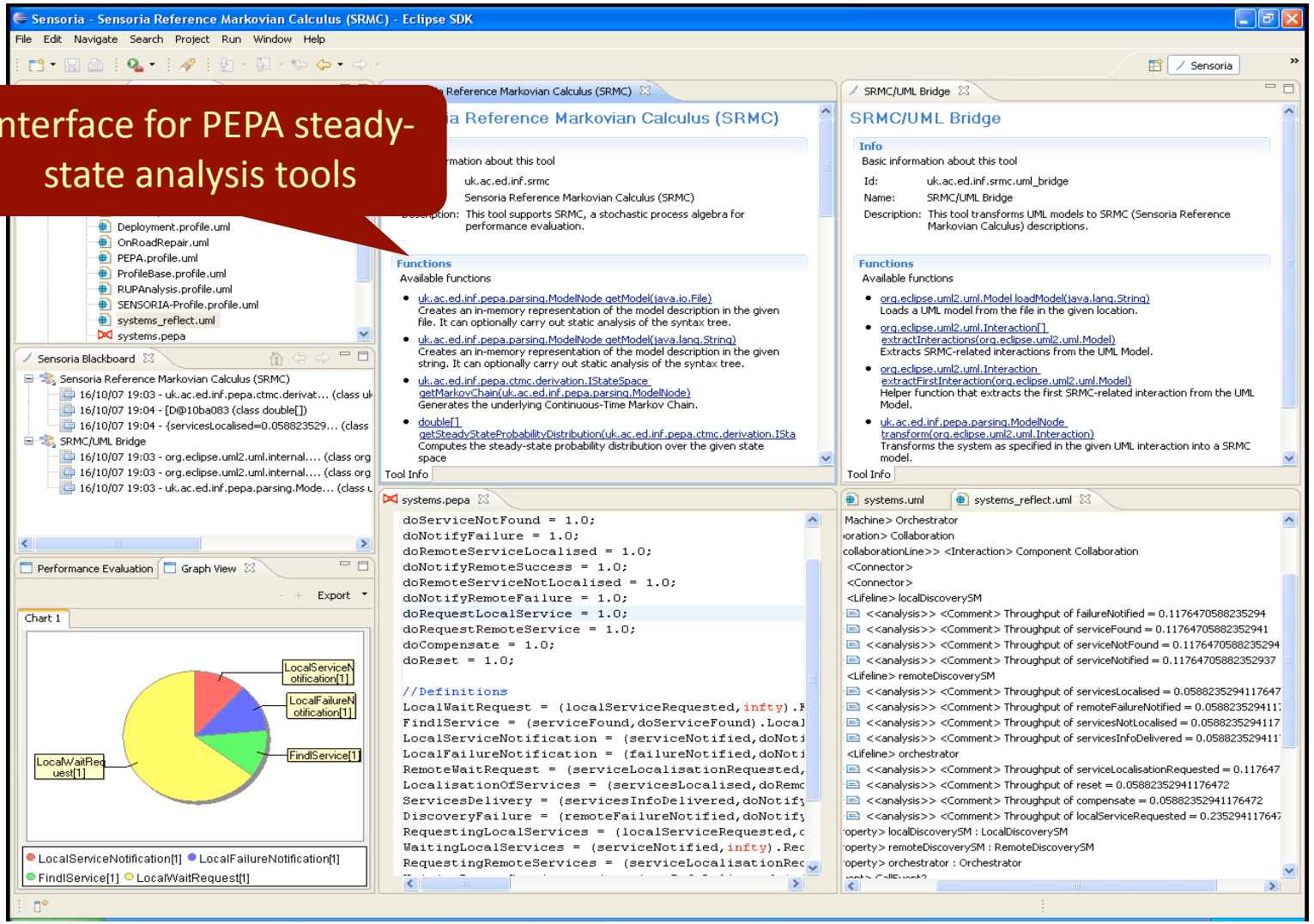
Performance analysis with PEPA

- PEPA is a formal language for quantitative analysis of systems
  - A model is expressed in terms of components which perform timed activities and co-operate with each other
- The SCT Plug-in for PEPA supports steady-state analysis, that can answer questions such as:
  - What is the percentage of time that the local discovery server is idle in the long run? (*Utilisation Analysis*)
  - What is the throughput at which remote services are discovered? (*Throughput Analysis*)
  - What is the probability that the system does compensation upon notification of failure?

PEPA at a Glance



PEPA at a Glance



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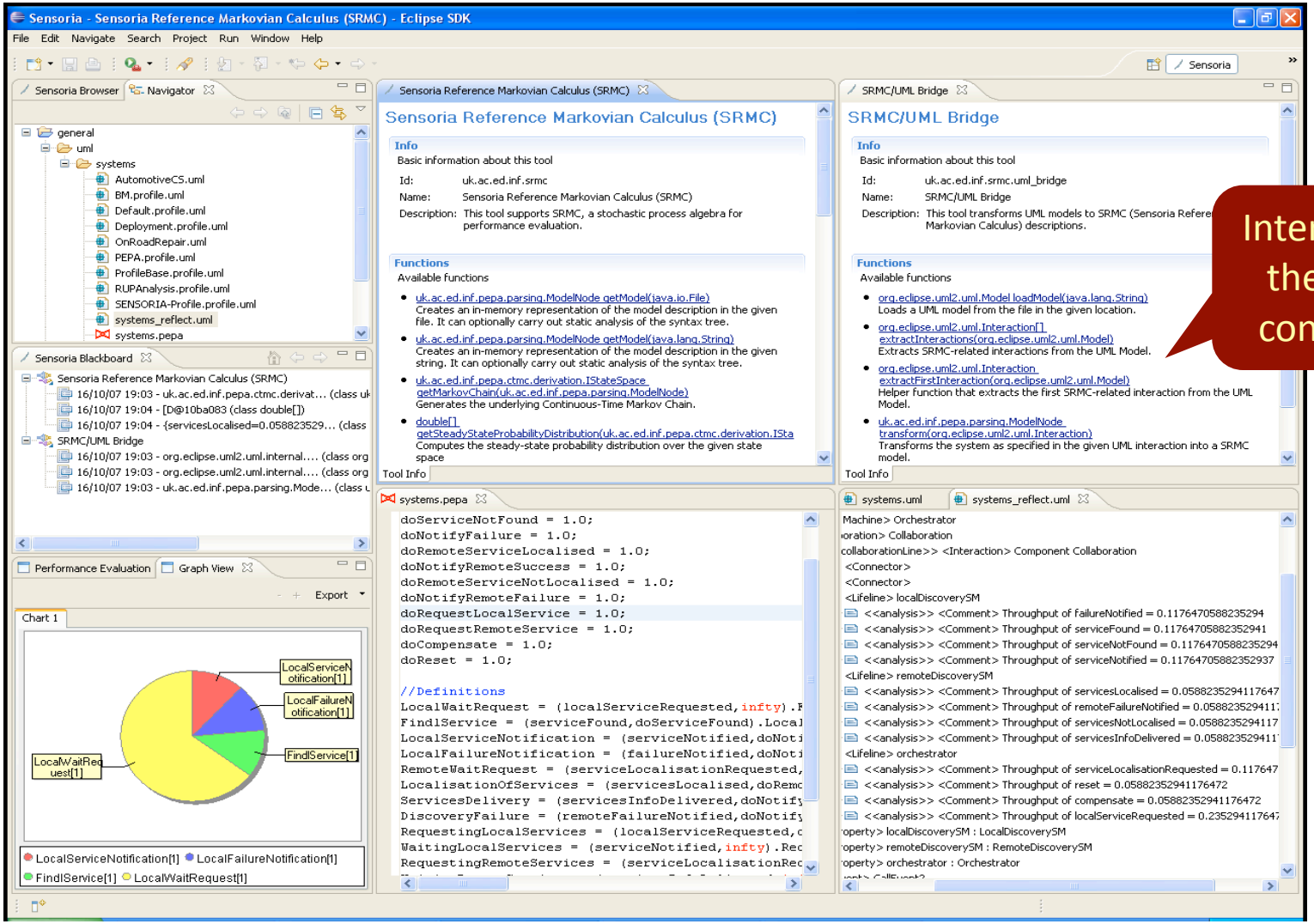

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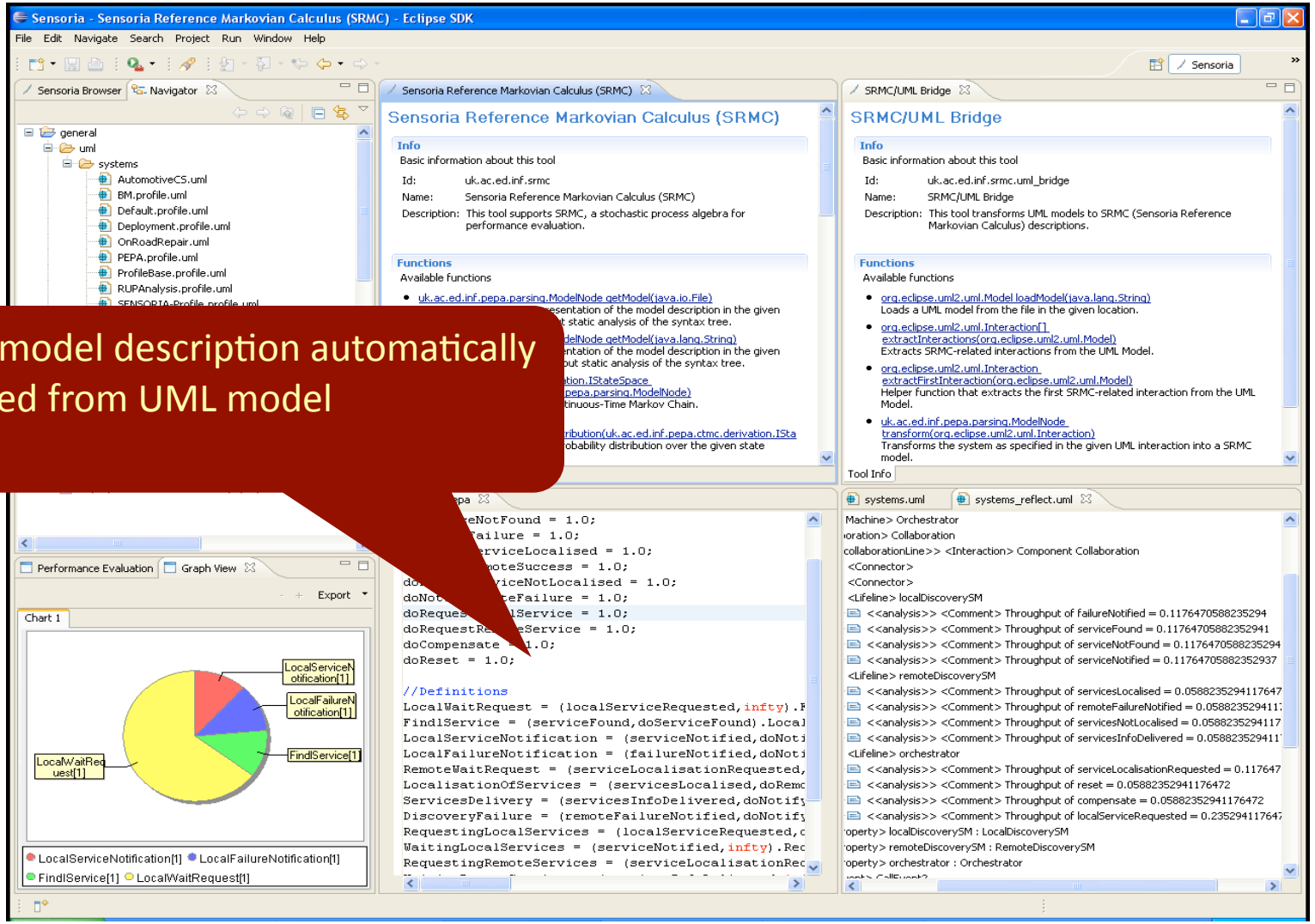
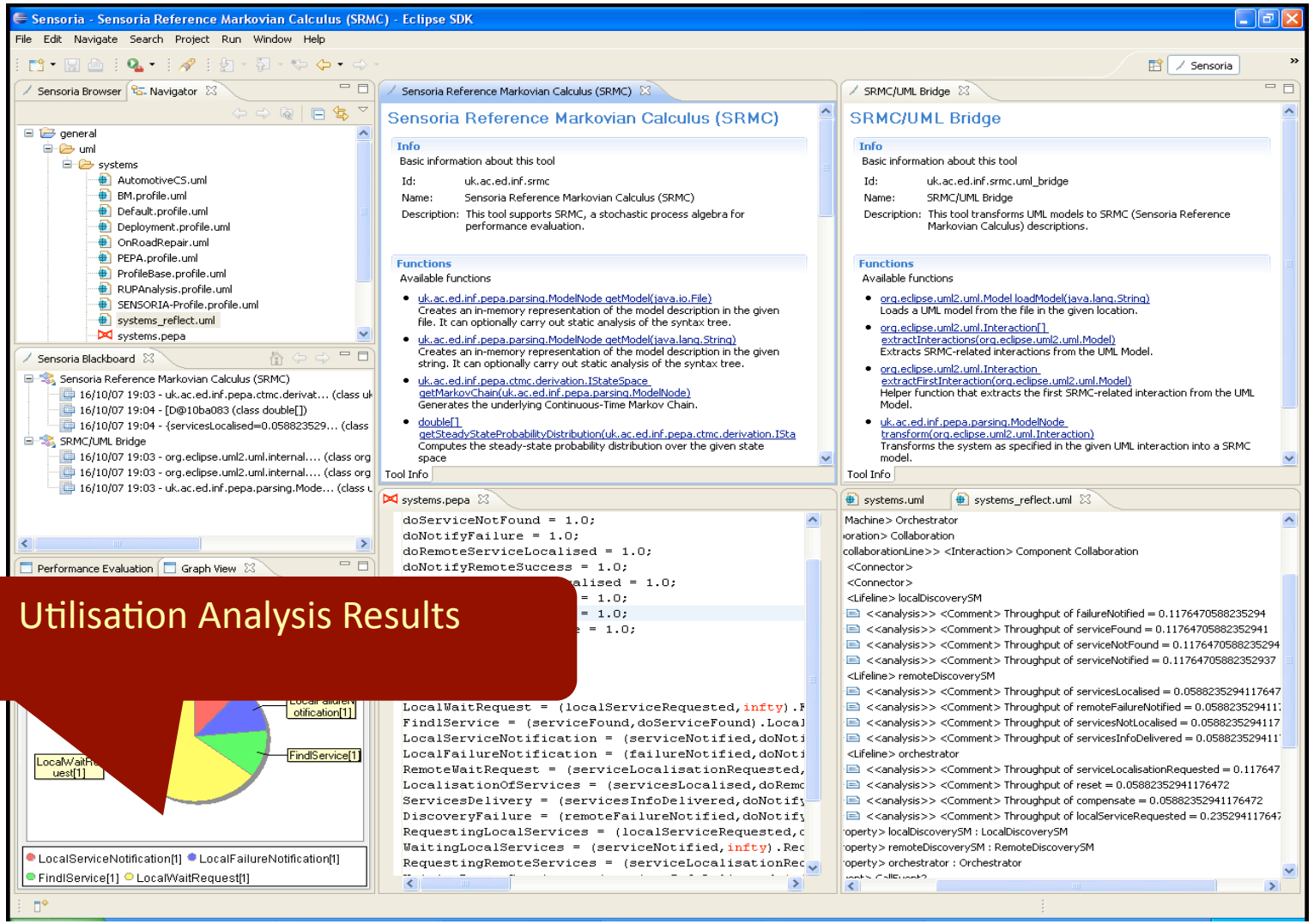


PEPA model description automatically inferred from UML model

PEPA at a Glance



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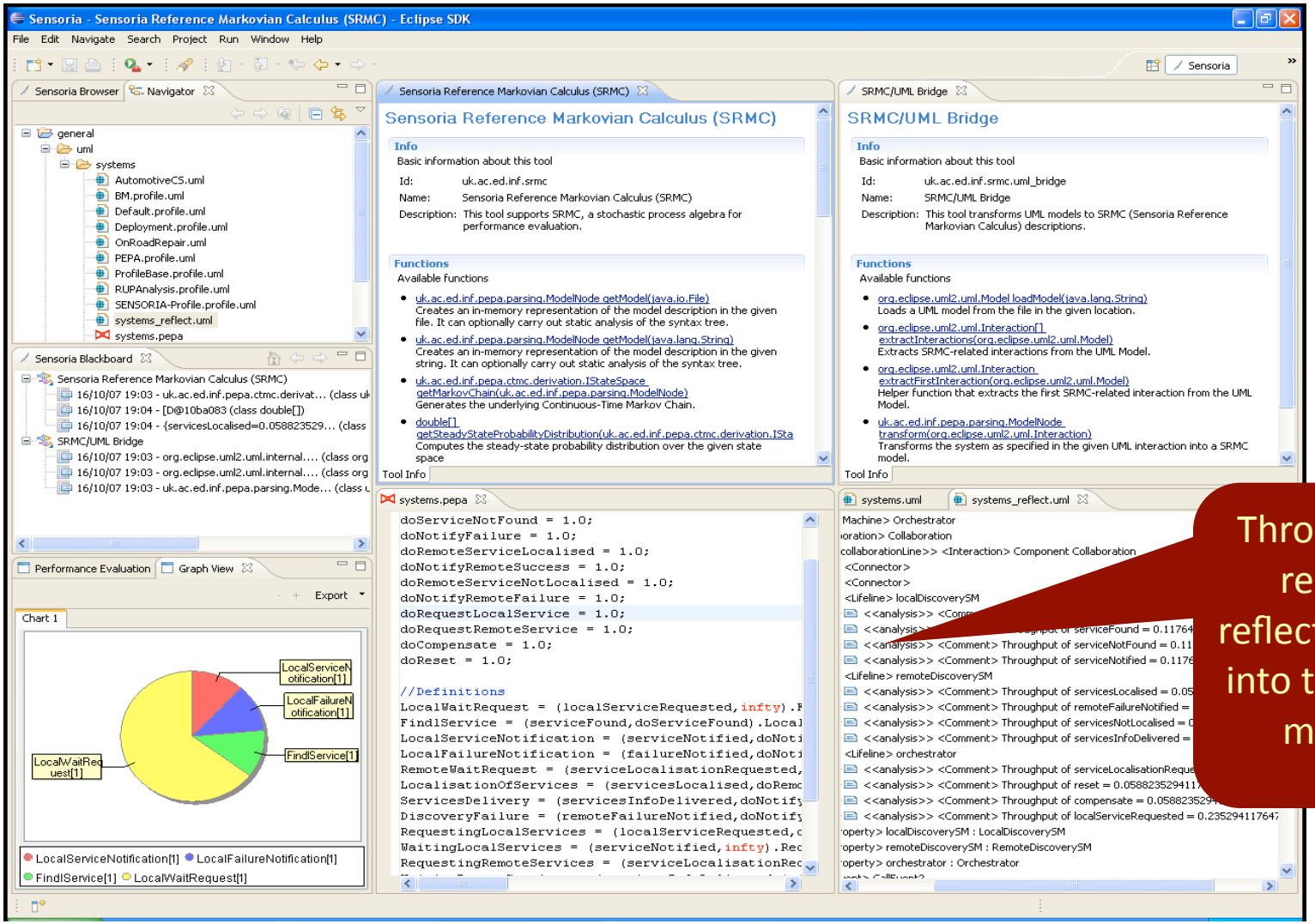

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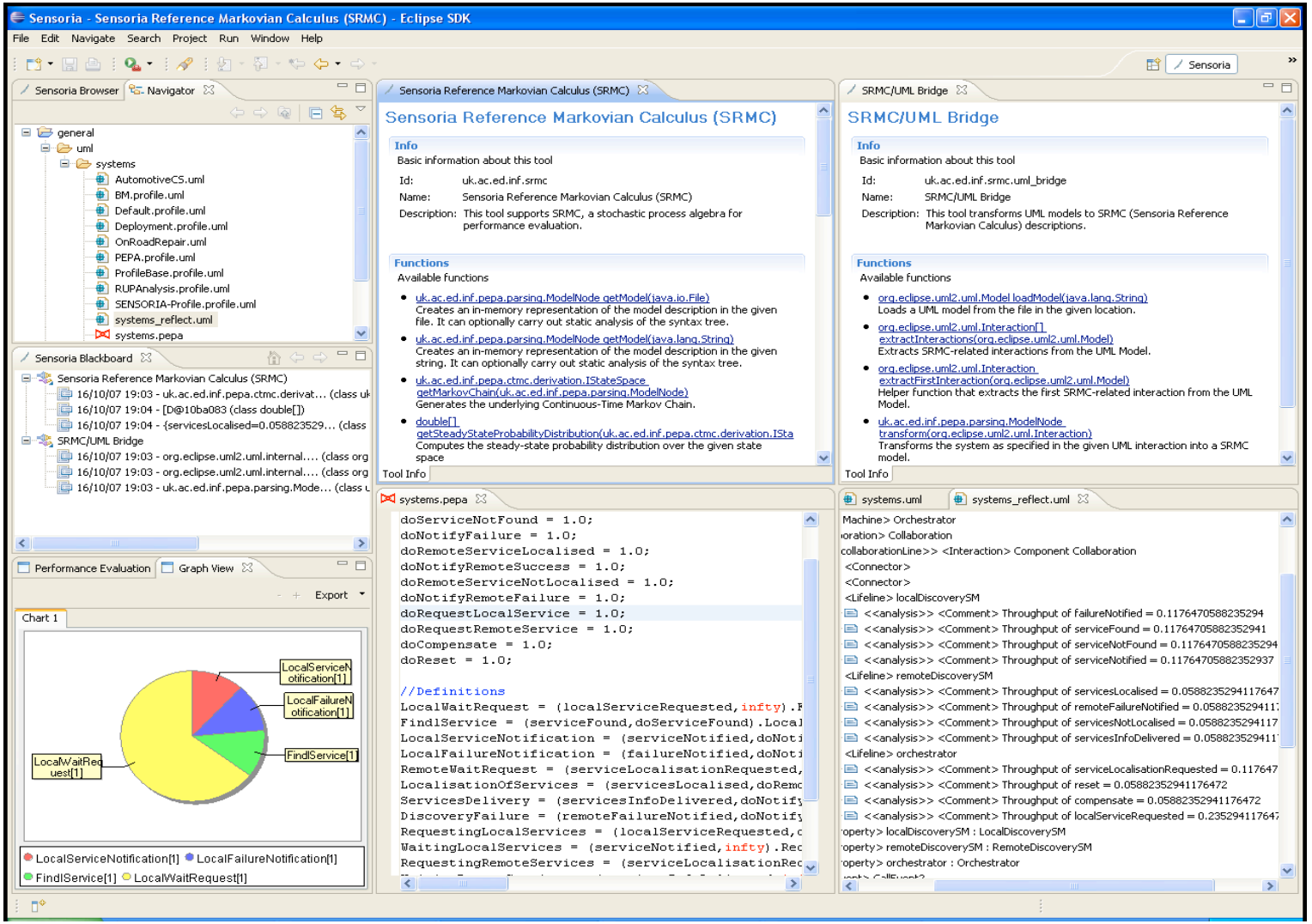
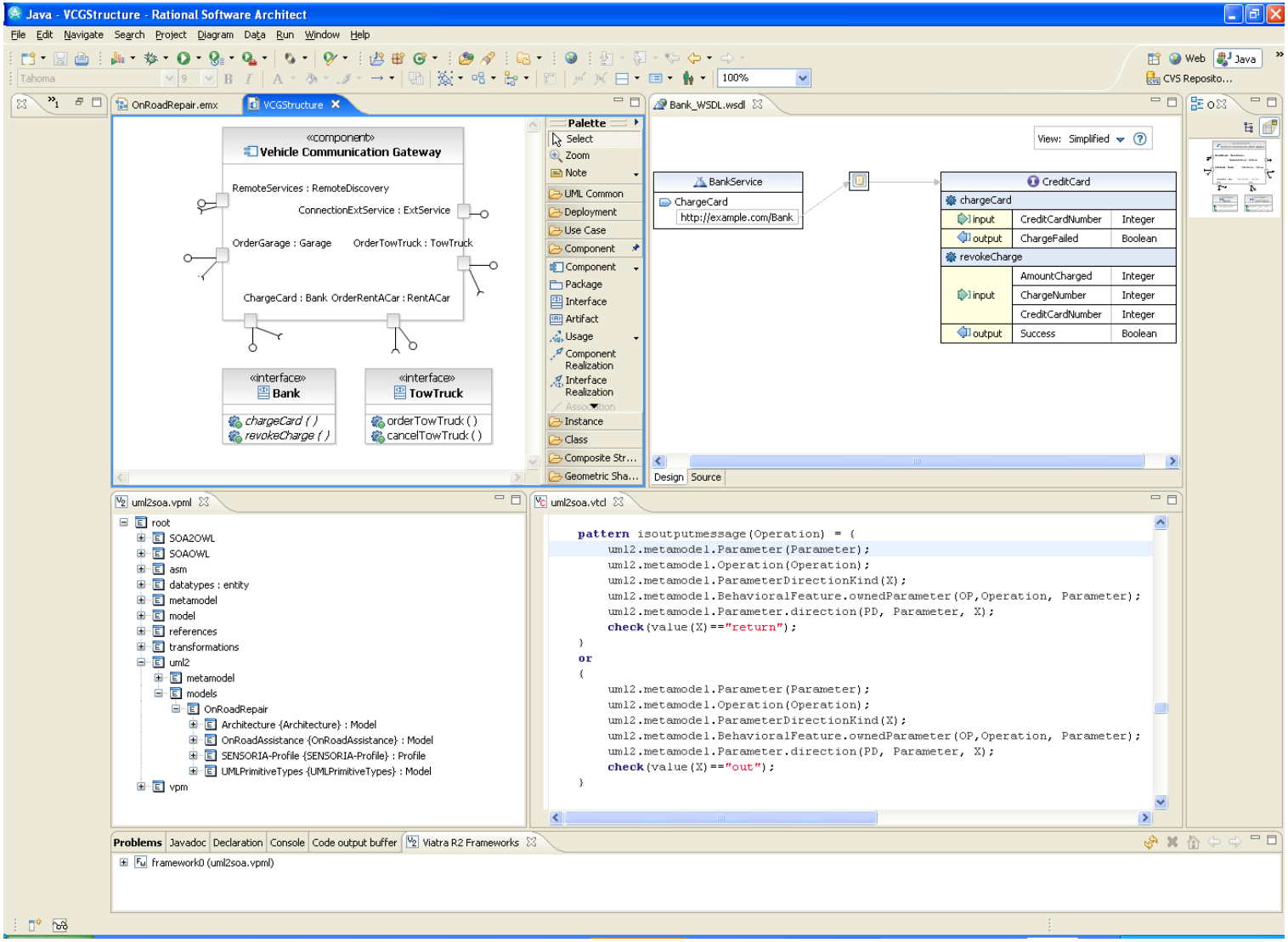


Service deployment transformations

- Generate WSDL descriptors from UML4SOA
- Tool: VIATRA2
  - **VI**sual **A**utomated model **TRA**nsformations
  - general-purpose model transformation framework that supports the entire life-cycle for transformations
    - specification
    - design
    - execution
    - validation
  - within and between various modeling languages
  - Eclipse subproject: http://eclipse.org/gmt
  - Wiki: http://wiki.eclipse.org/VIATRA2

VIATRA2 transformations in SDE



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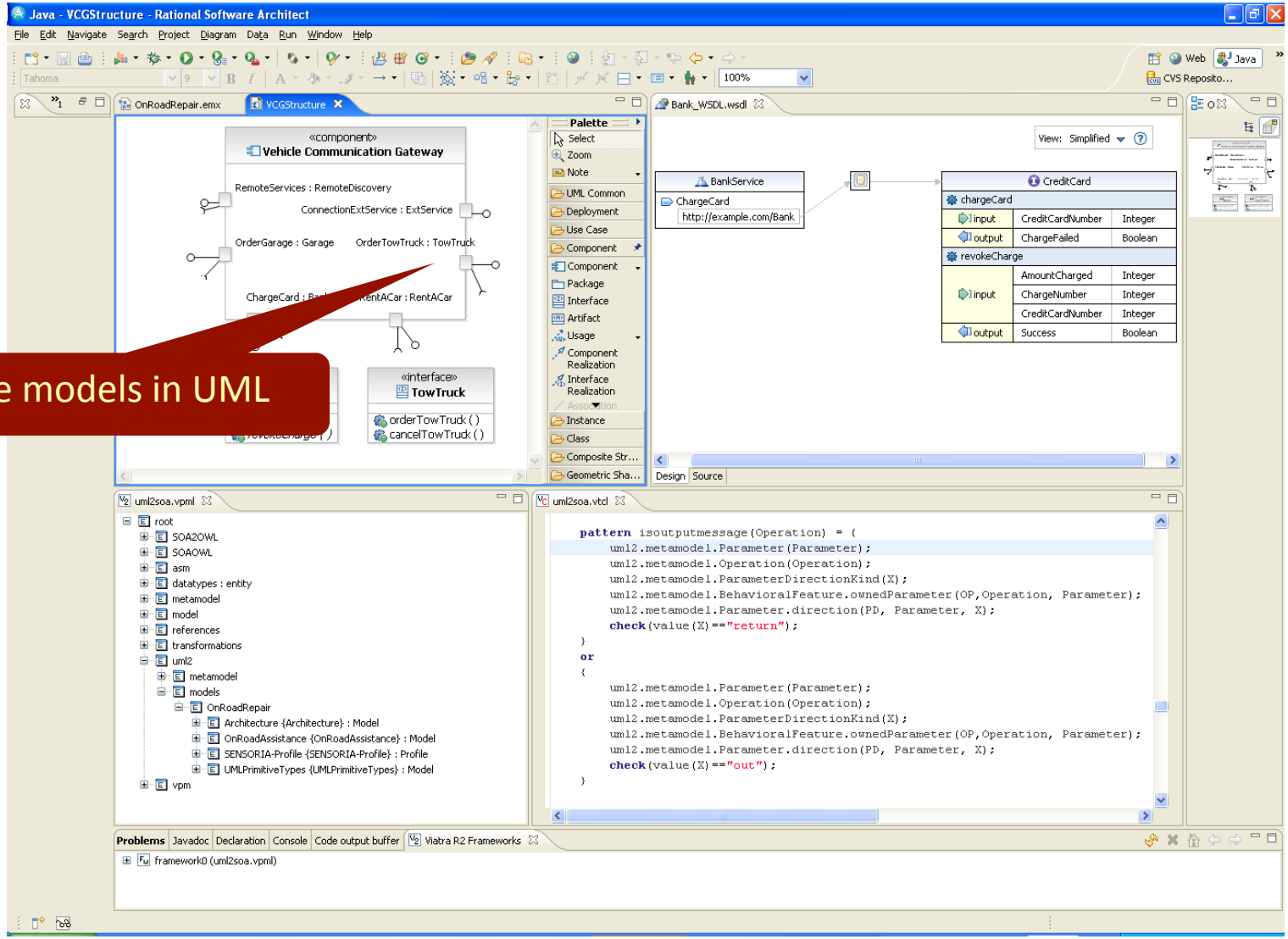
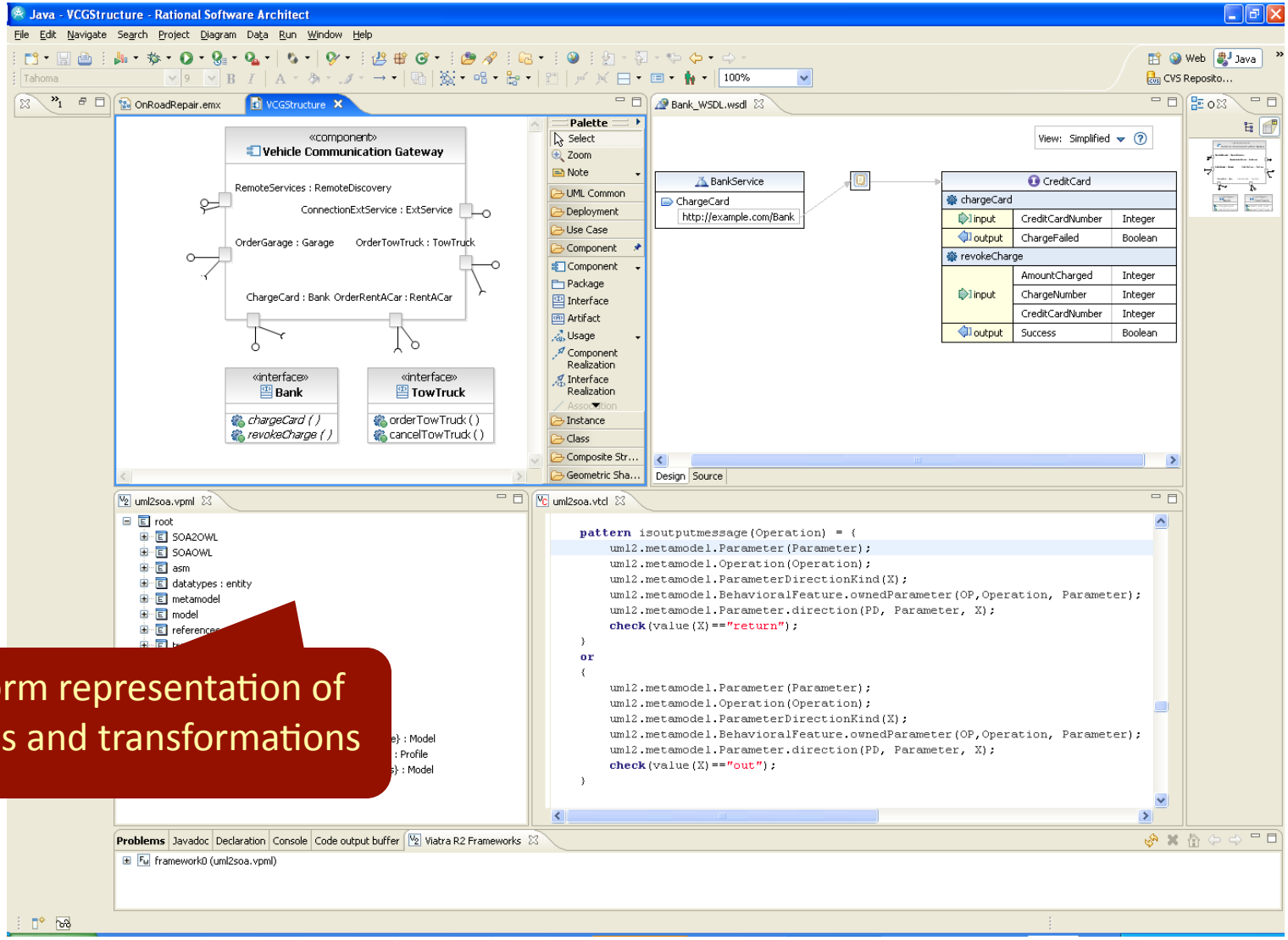


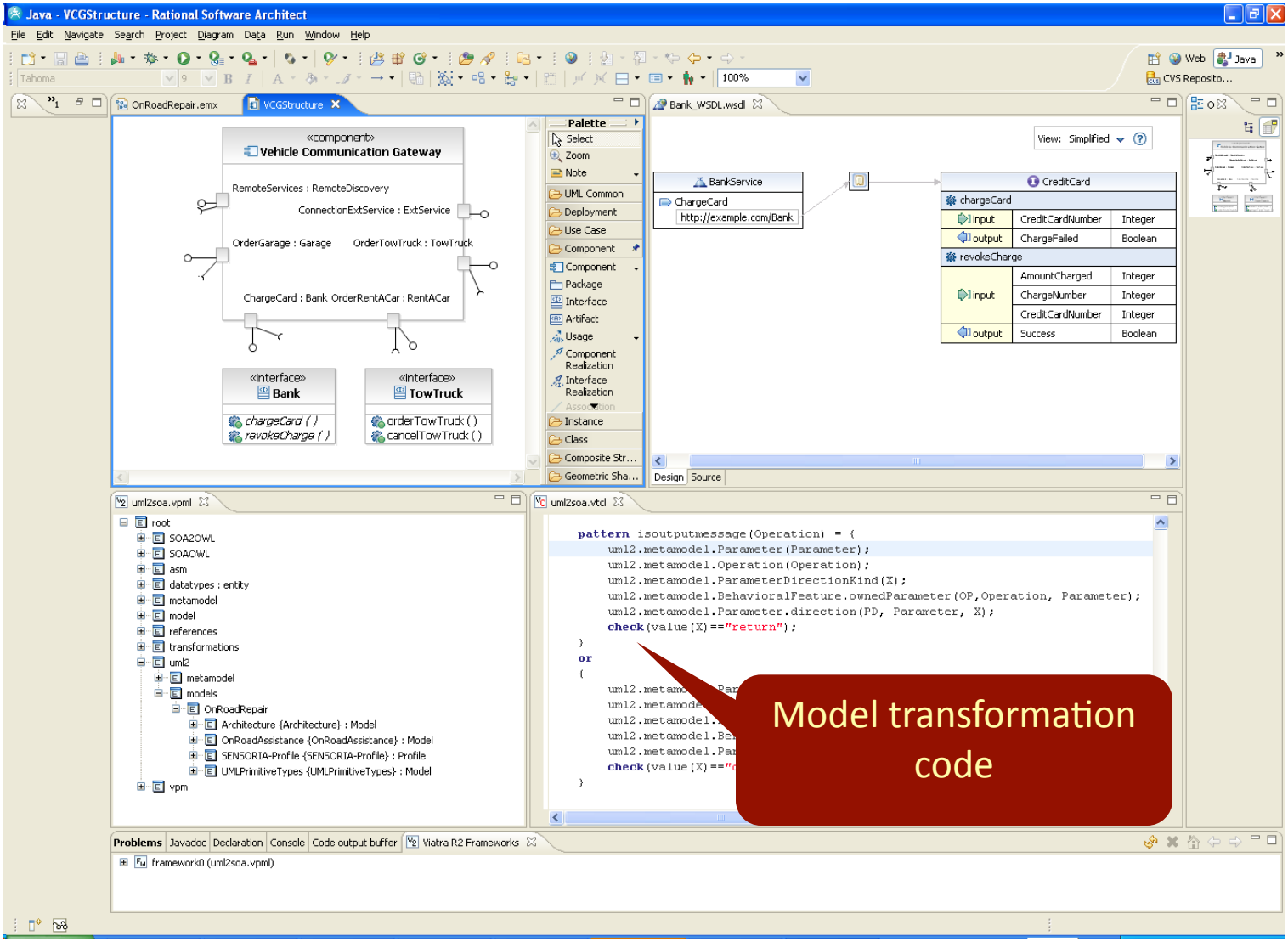
Source models in UML

VIATRA2 transformations in SDE



Uniform representation of models and transformations

VIATRA2 transformations in SDE



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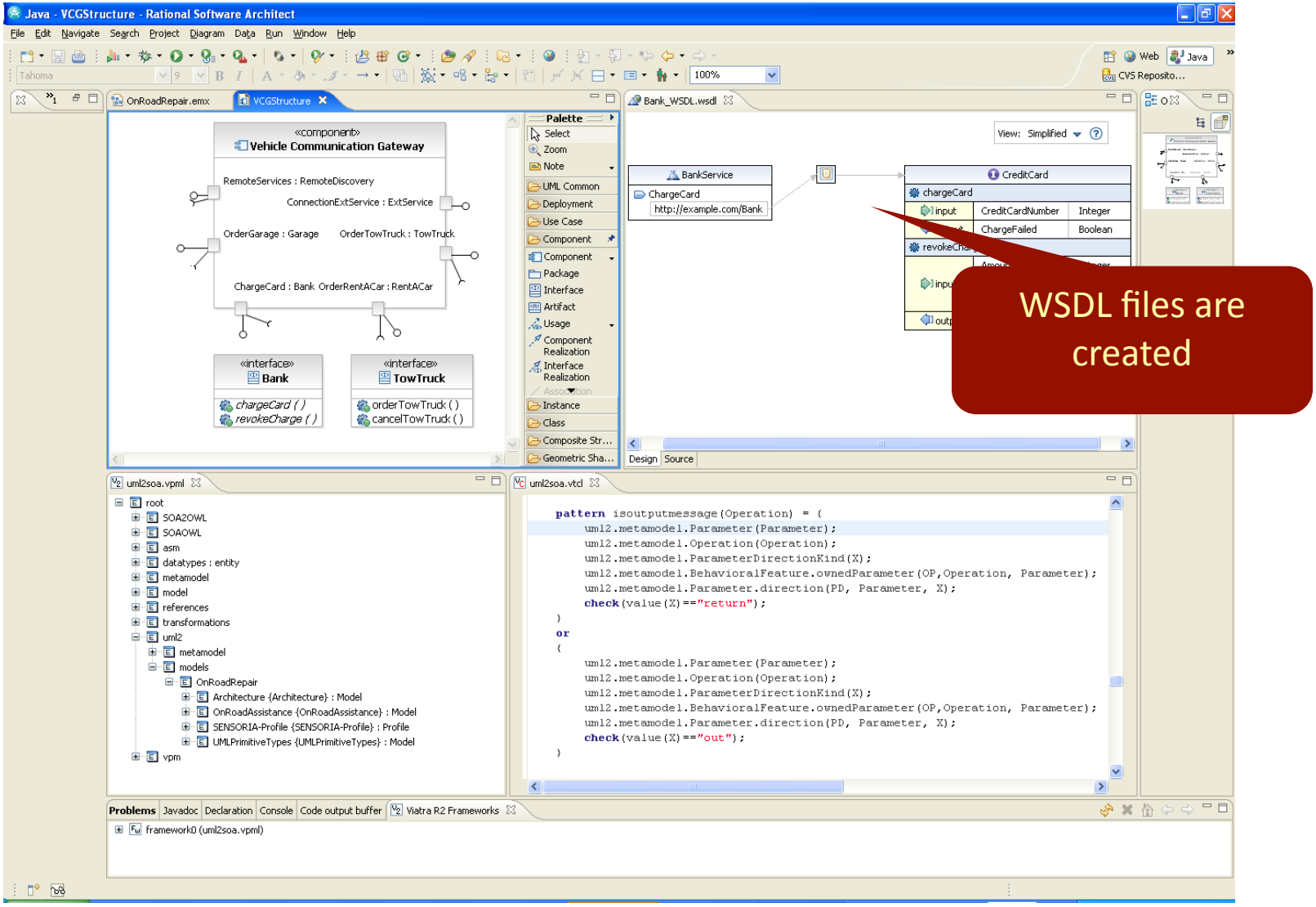

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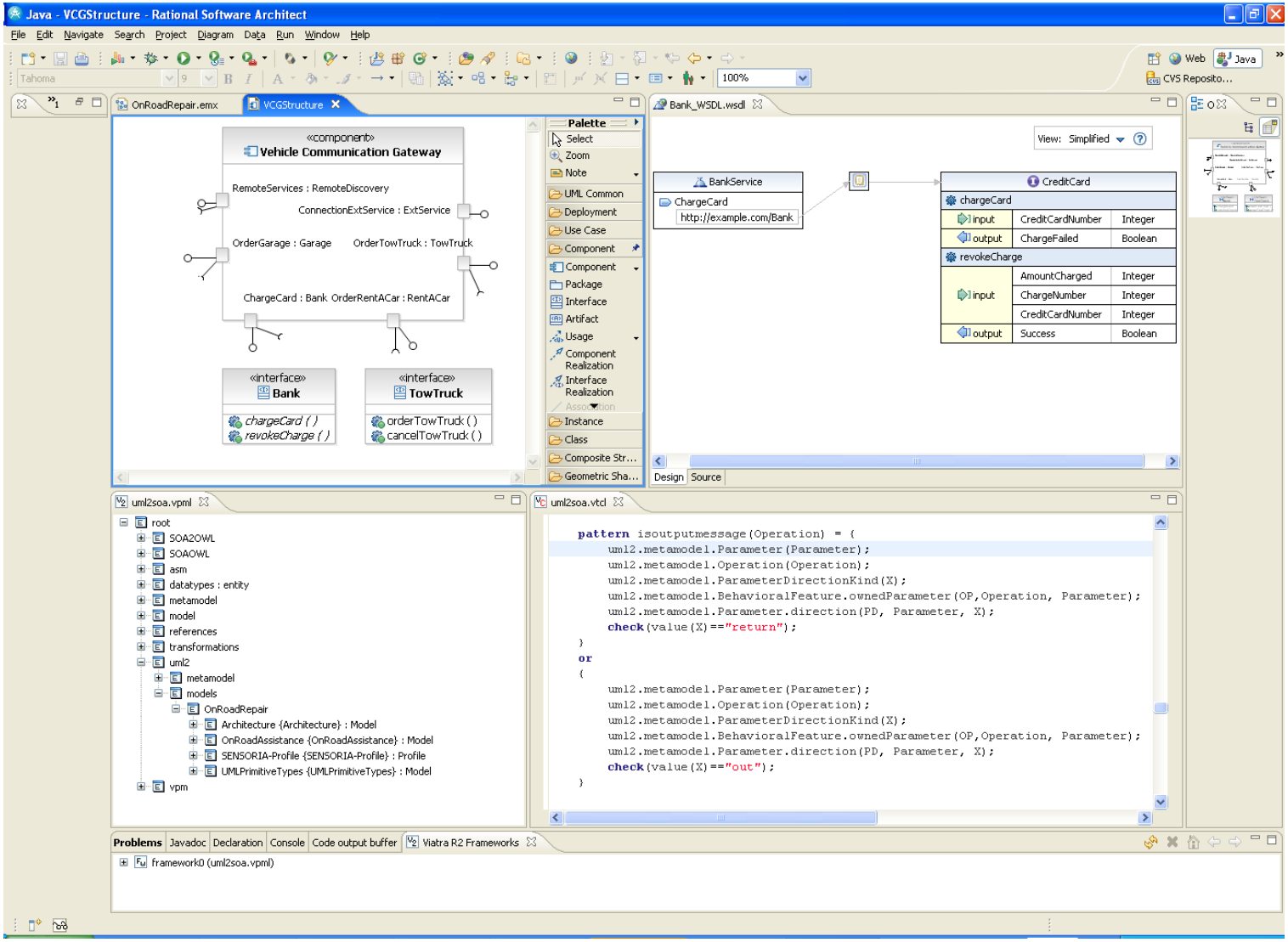
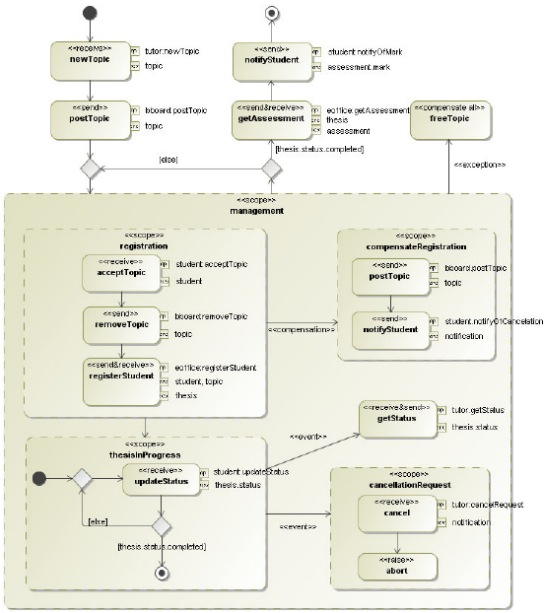


The UML2BPEL Transformation

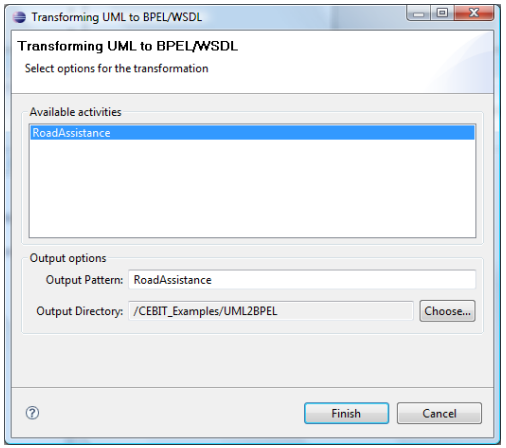
- **The UML2BPEL transformer converts from UML activity diagrams to BPEL and WSDL**
  - Input: Service orchestrations in UML based on the UML4SOA profile
  - Output: BPEL and WSDL files
- **Integrated into Eclipse**
- **Based on Eclipse EMF, supports input models from Rational Software Architect and other tools which export EMF XMI**
- **See http://www.pst.ifi.lmu.de/projekte/uml4soa/**

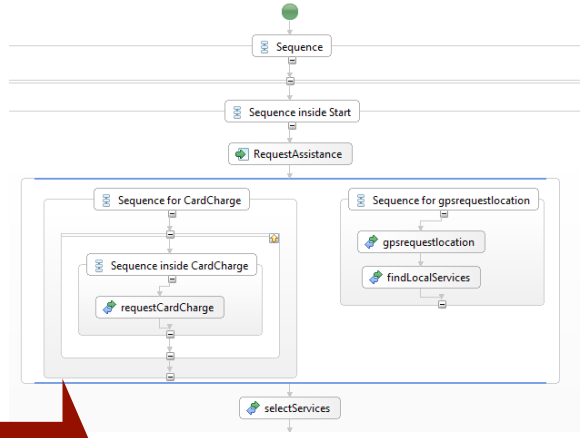
UML2BPEL at a glance



UML

Transformation

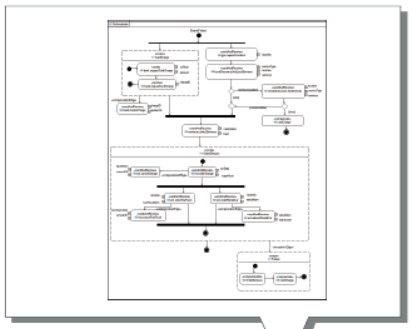


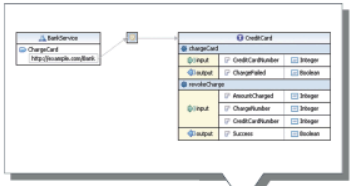


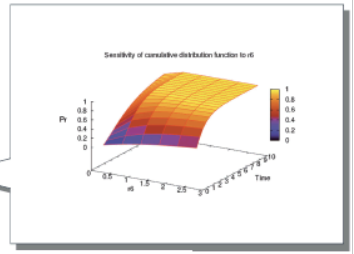
BPEL + WSDL

SENSORIA provides…

SENSORIA tools extend standard design workflow







Analysis

Verifying correctness of SOA models/code
e.g., PEPA Tool, WS-Engineer

Transformation

Translating SOA artefacts between steps
e.g., BPEL to WSDL, VIATRA 2, TIGER

Modelling and Languages

Modelling SOA applications
e.g., a UML Profile for SOA

Deployment and Runtime

Deployment and Execution of SOA systems
e.g., dynamic matching of services

SENSORIA CASE Tool Integration Platform

OSGi

SENSORIA provides…

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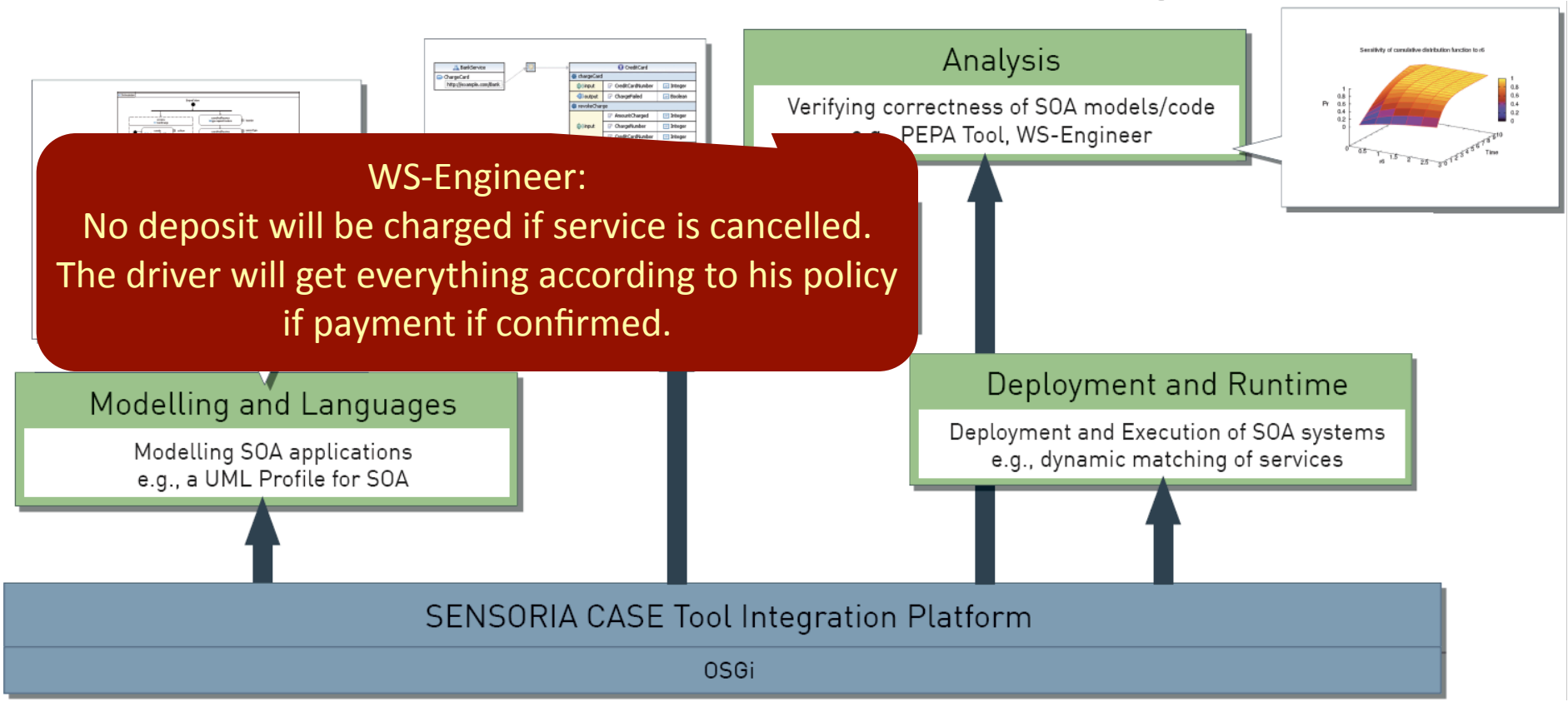

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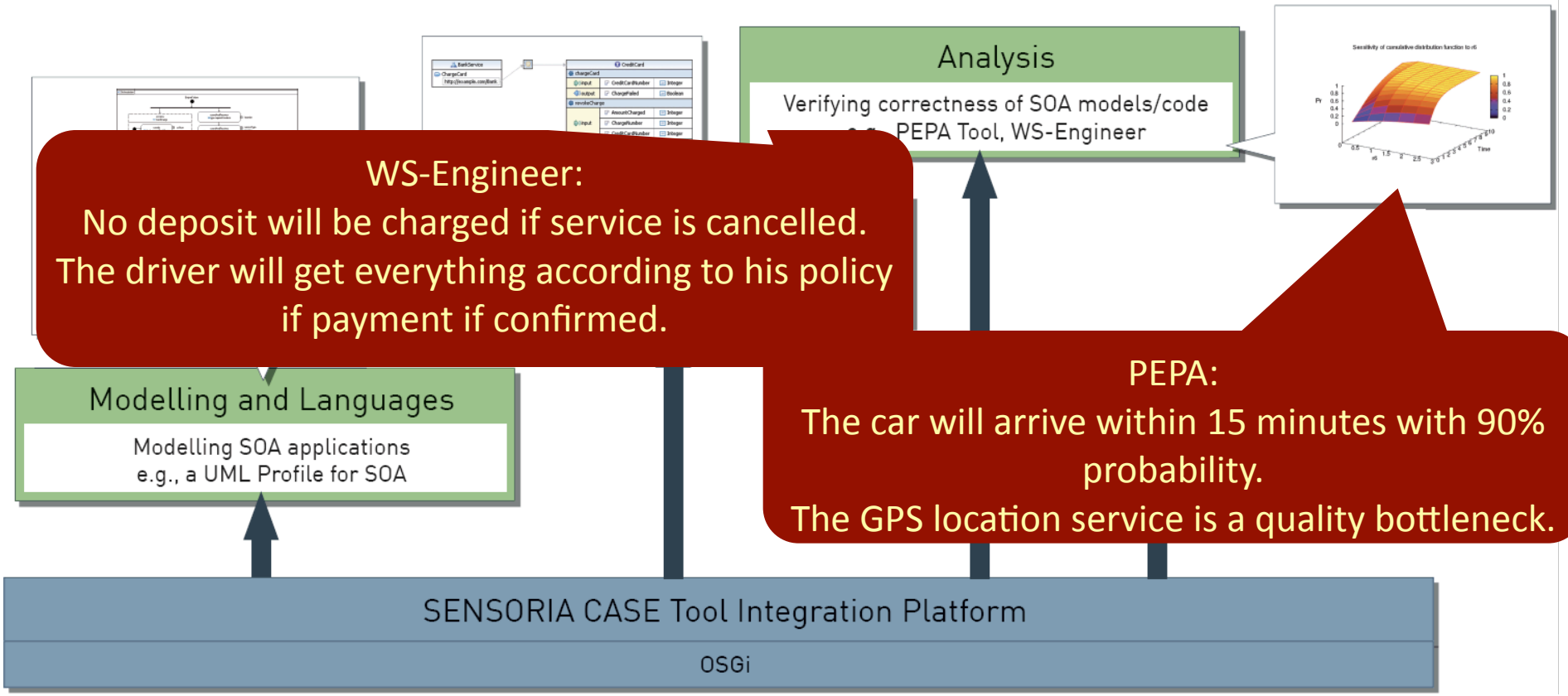

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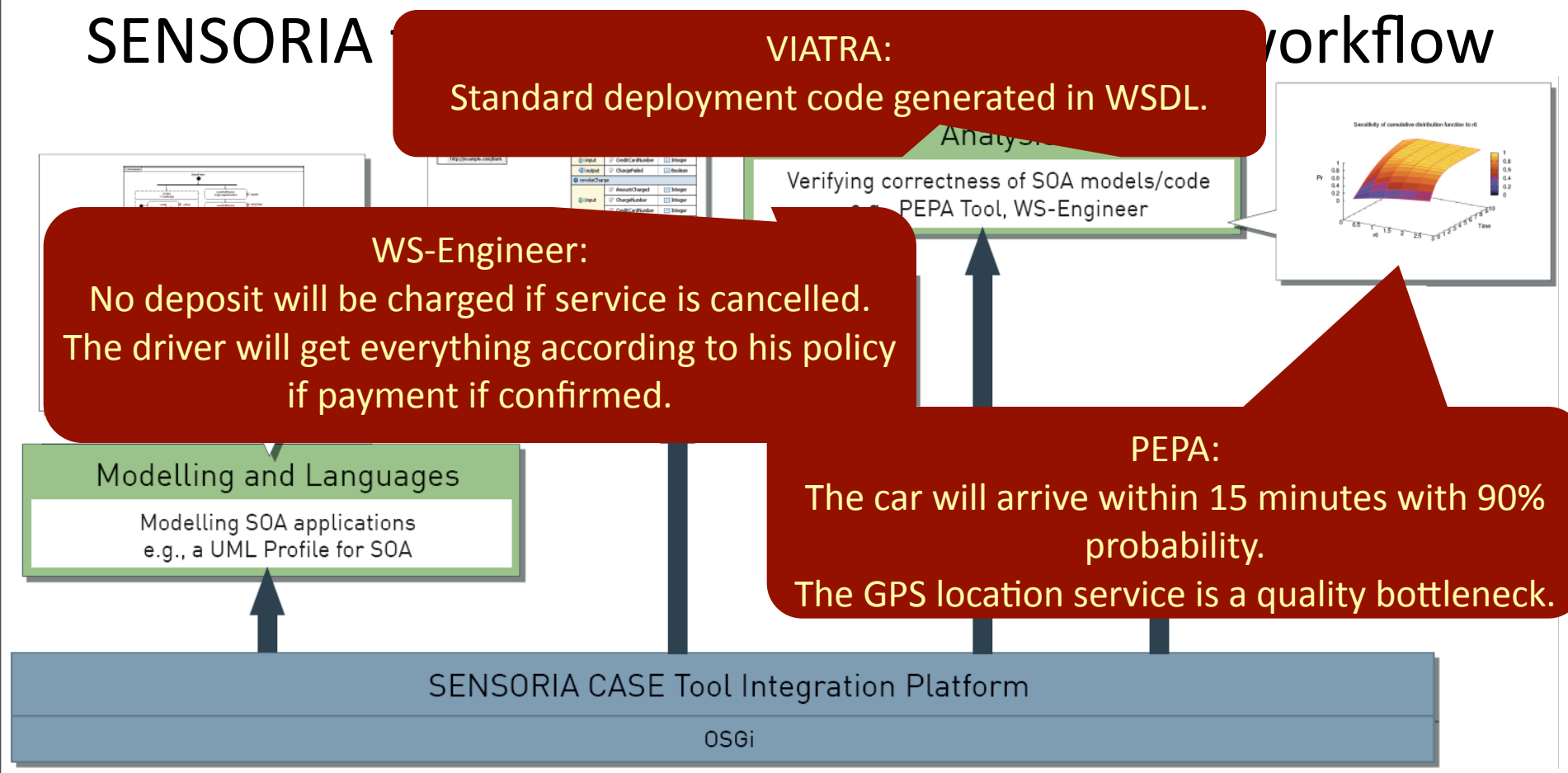

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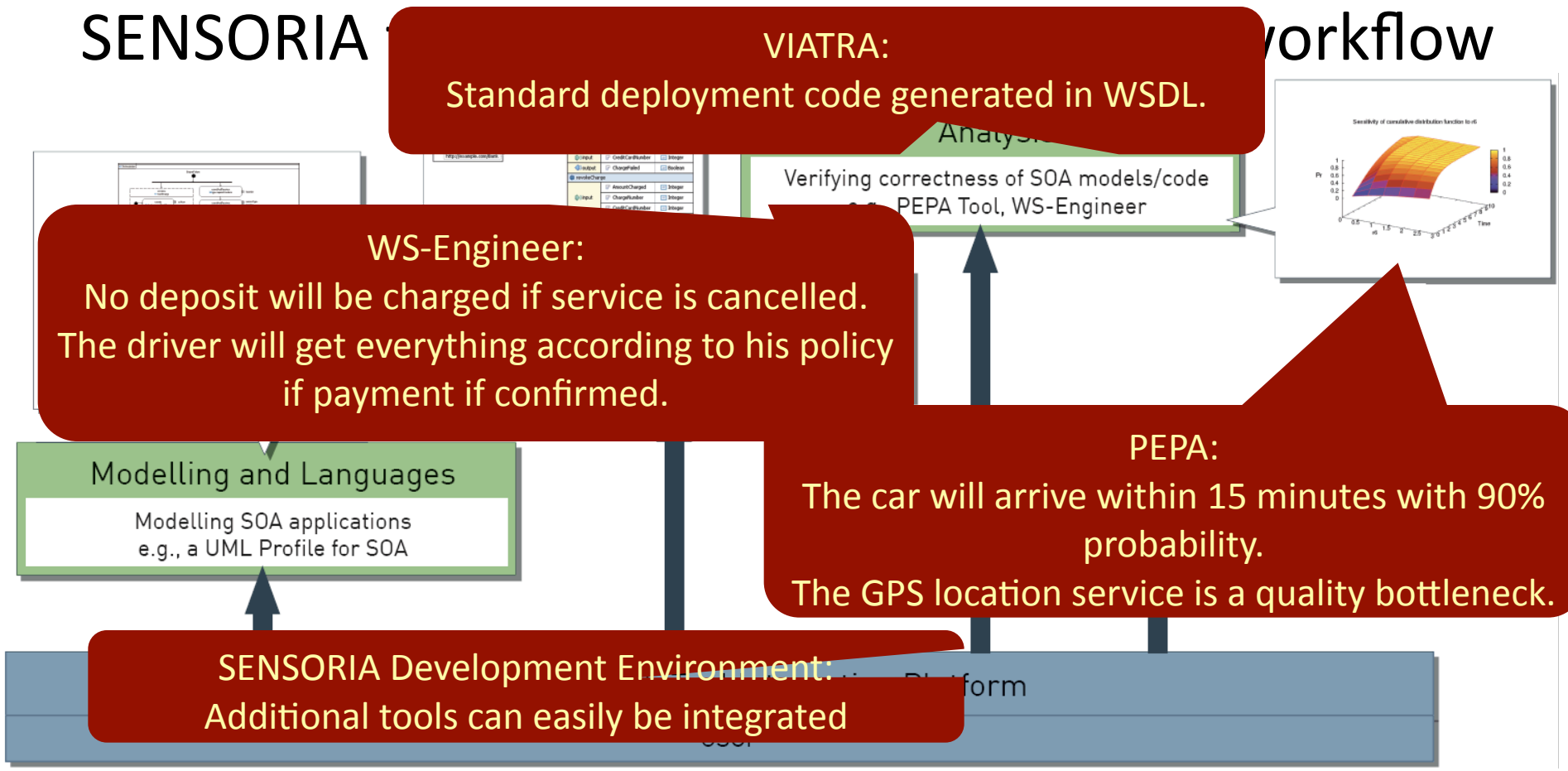
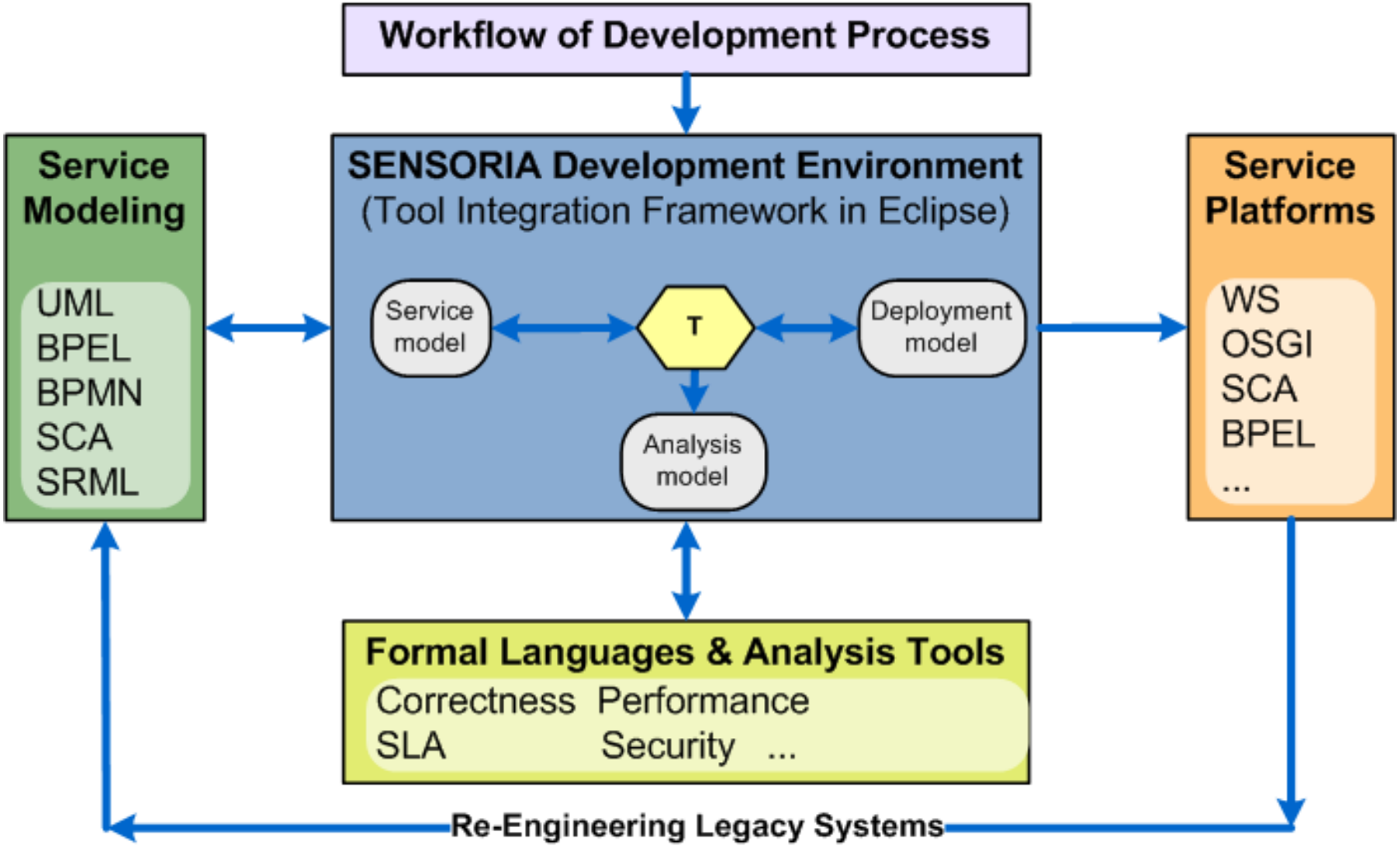


SENSORIA answers to SOA challenges



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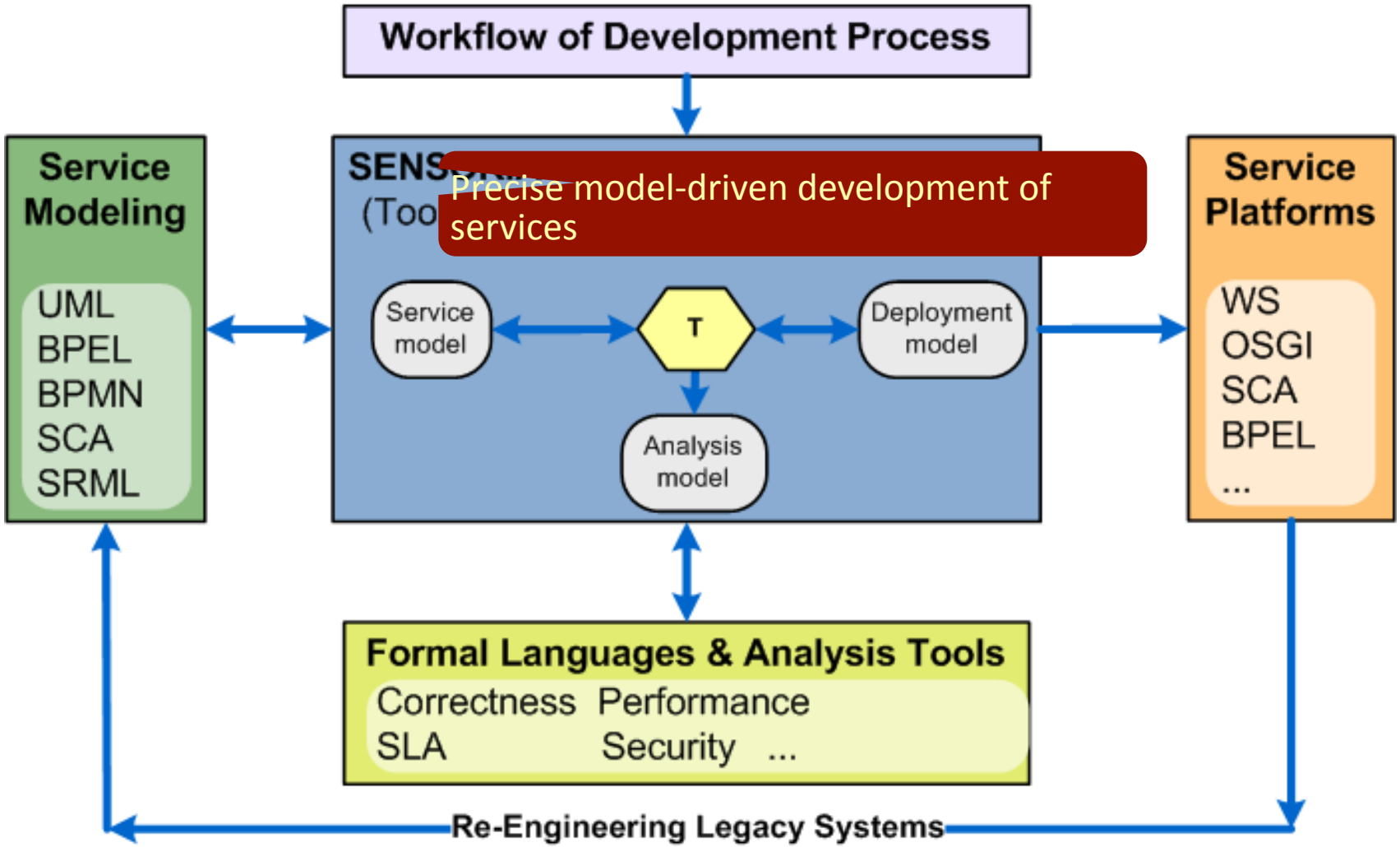

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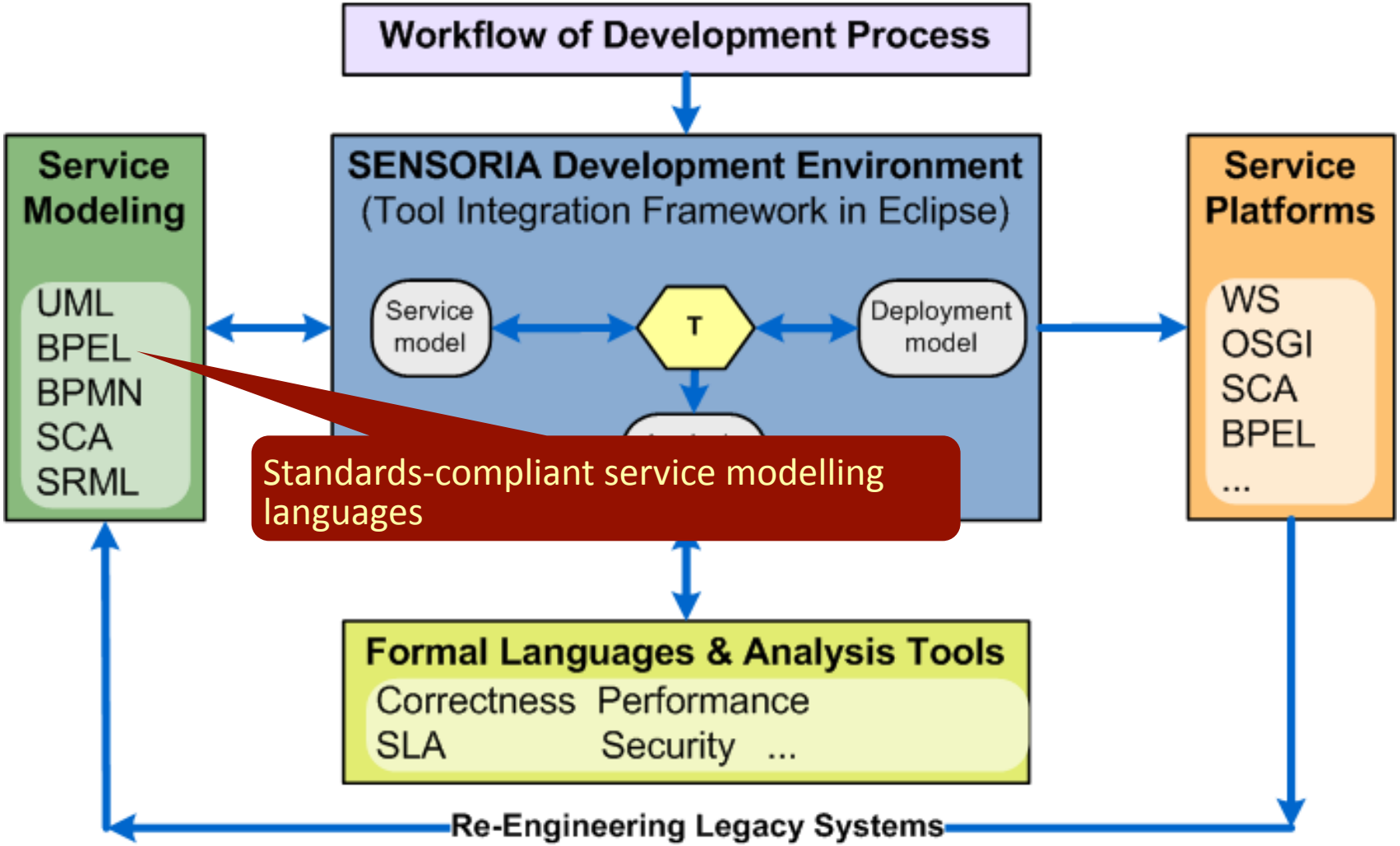

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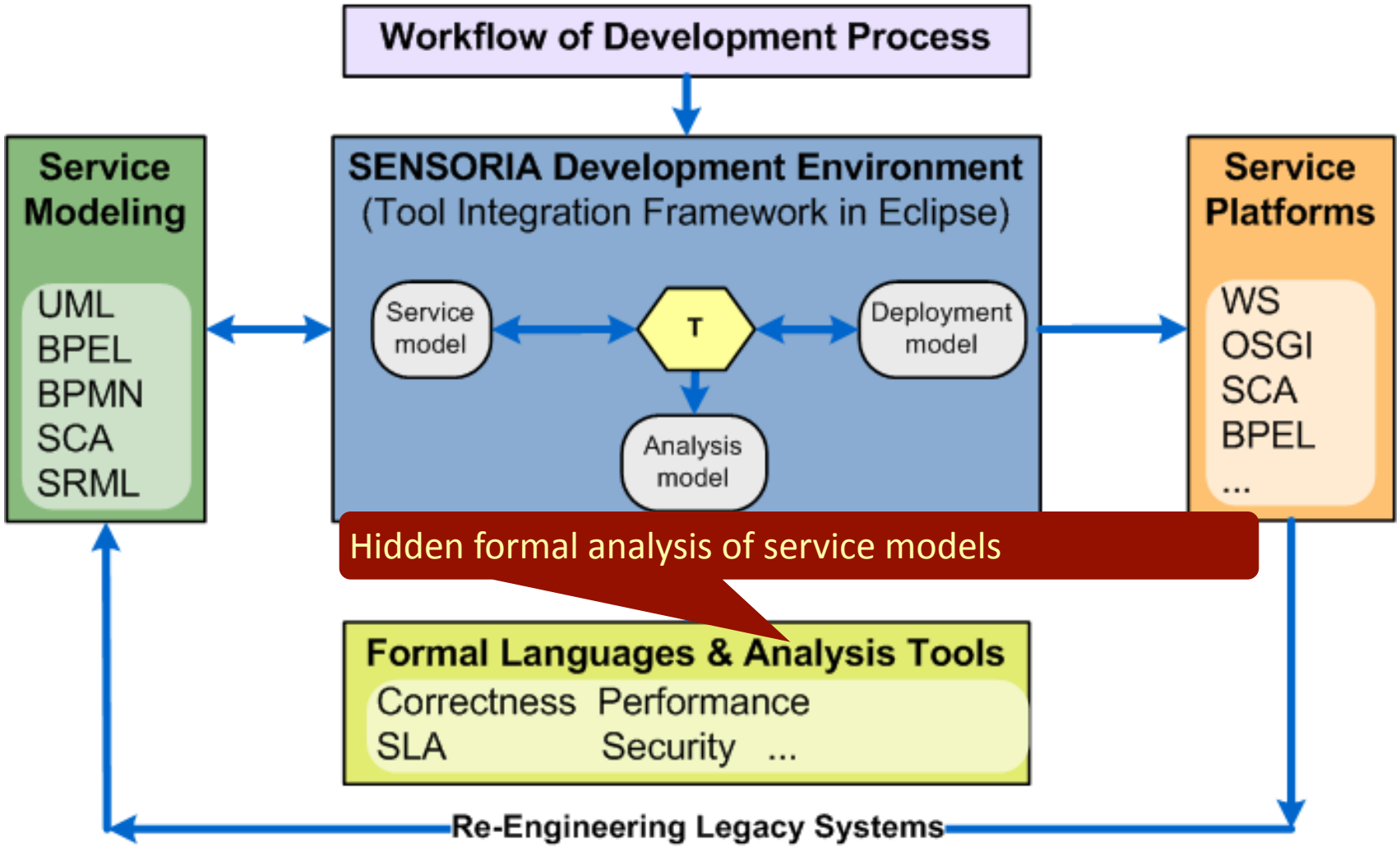

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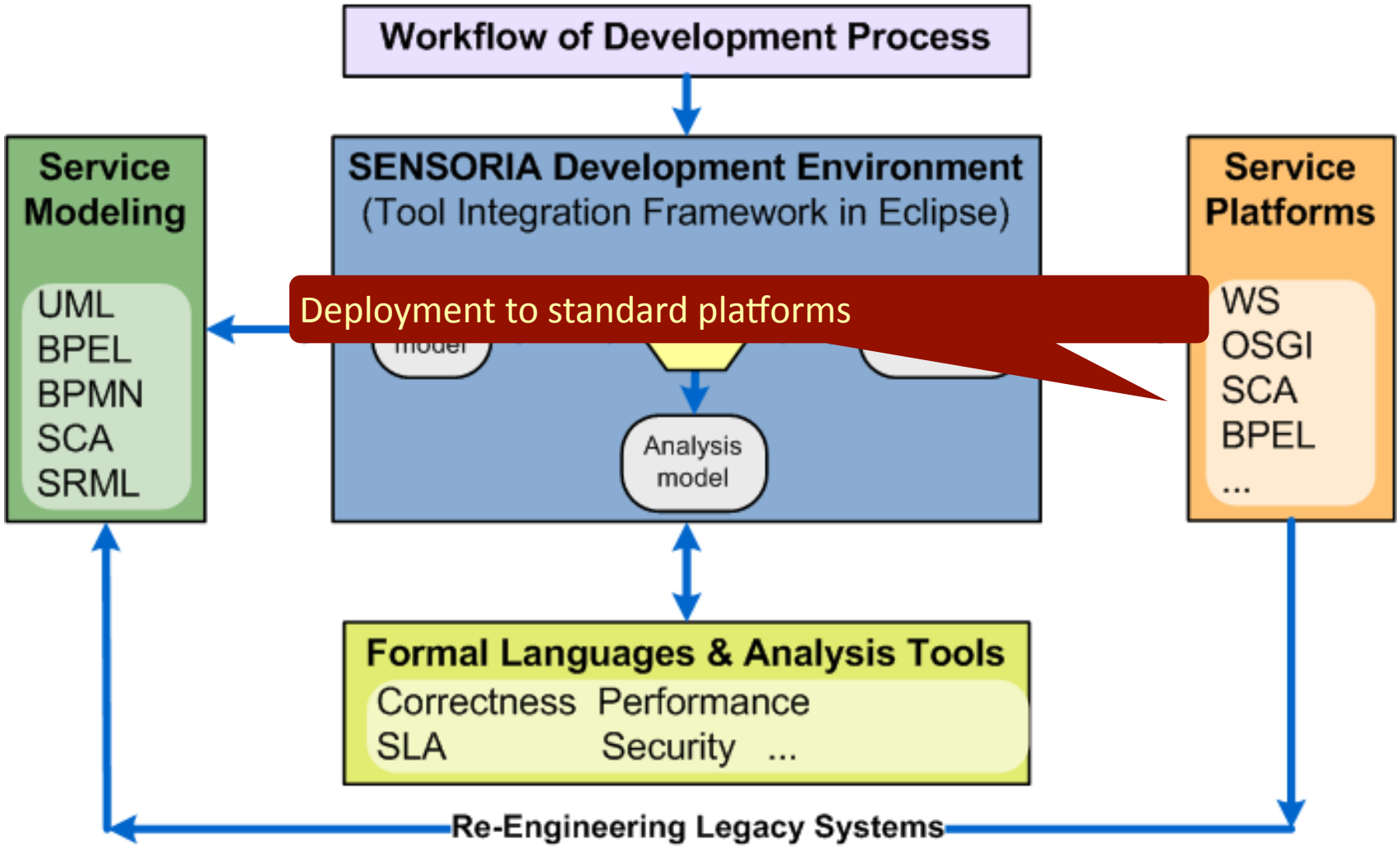

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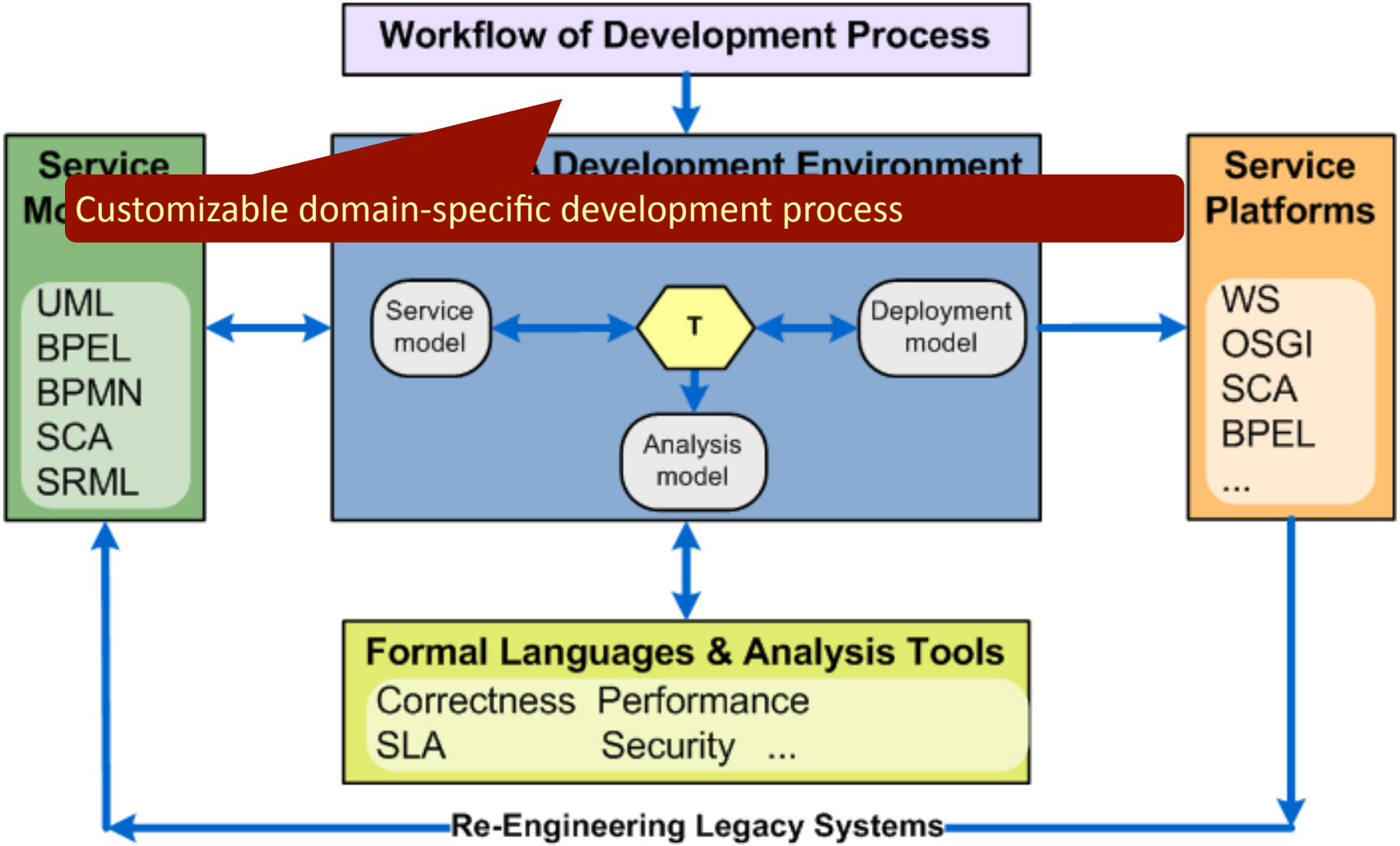
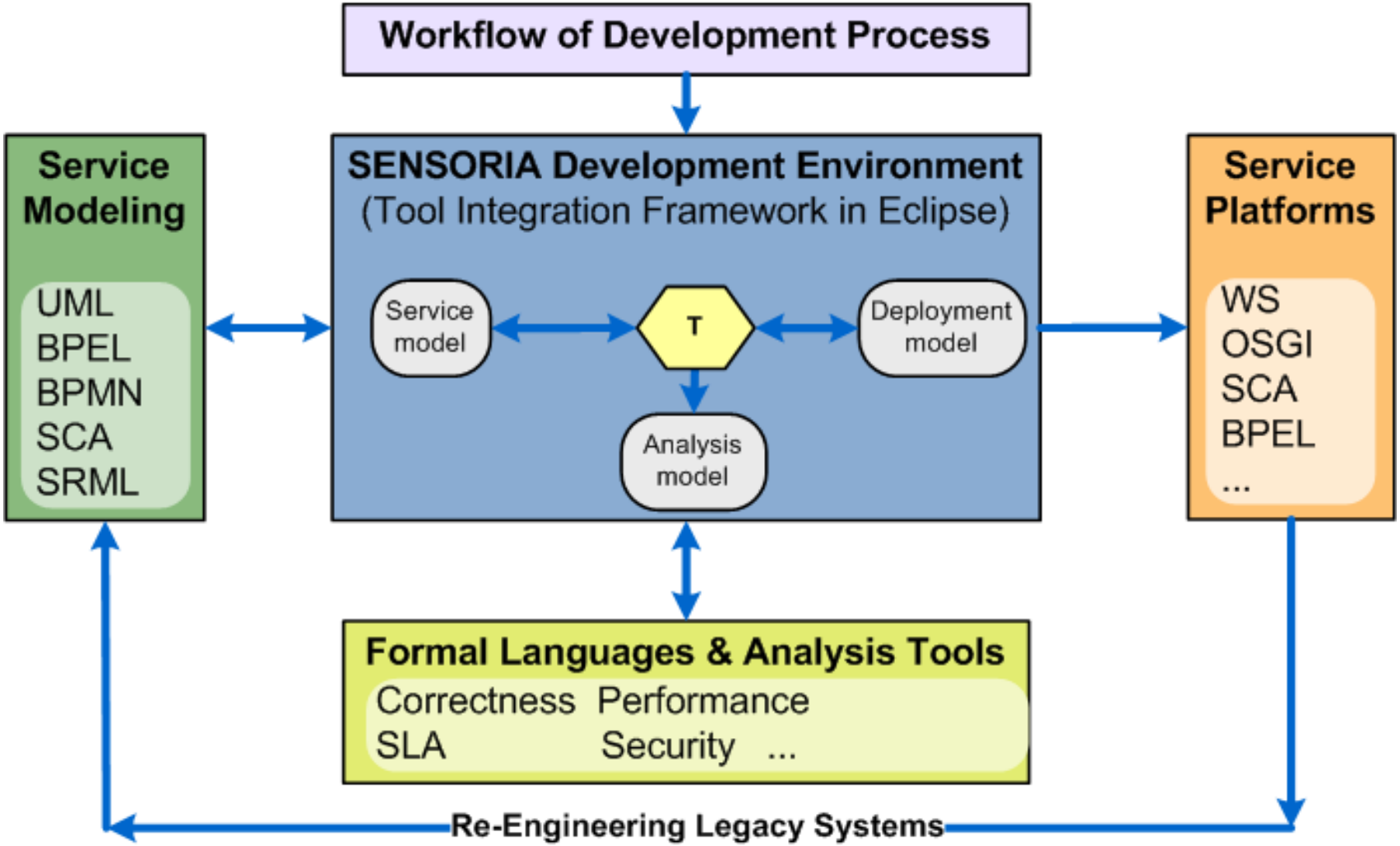


SENSORIA answers to SOA challenges

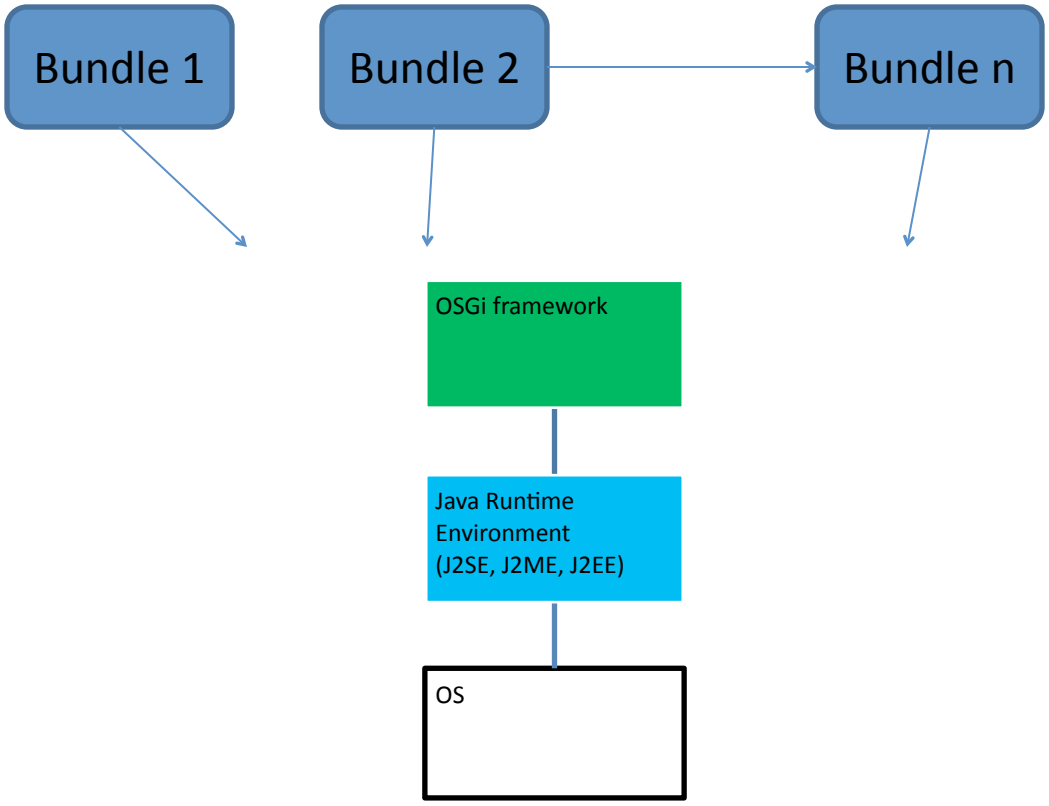


The SENSORIA Development Environment

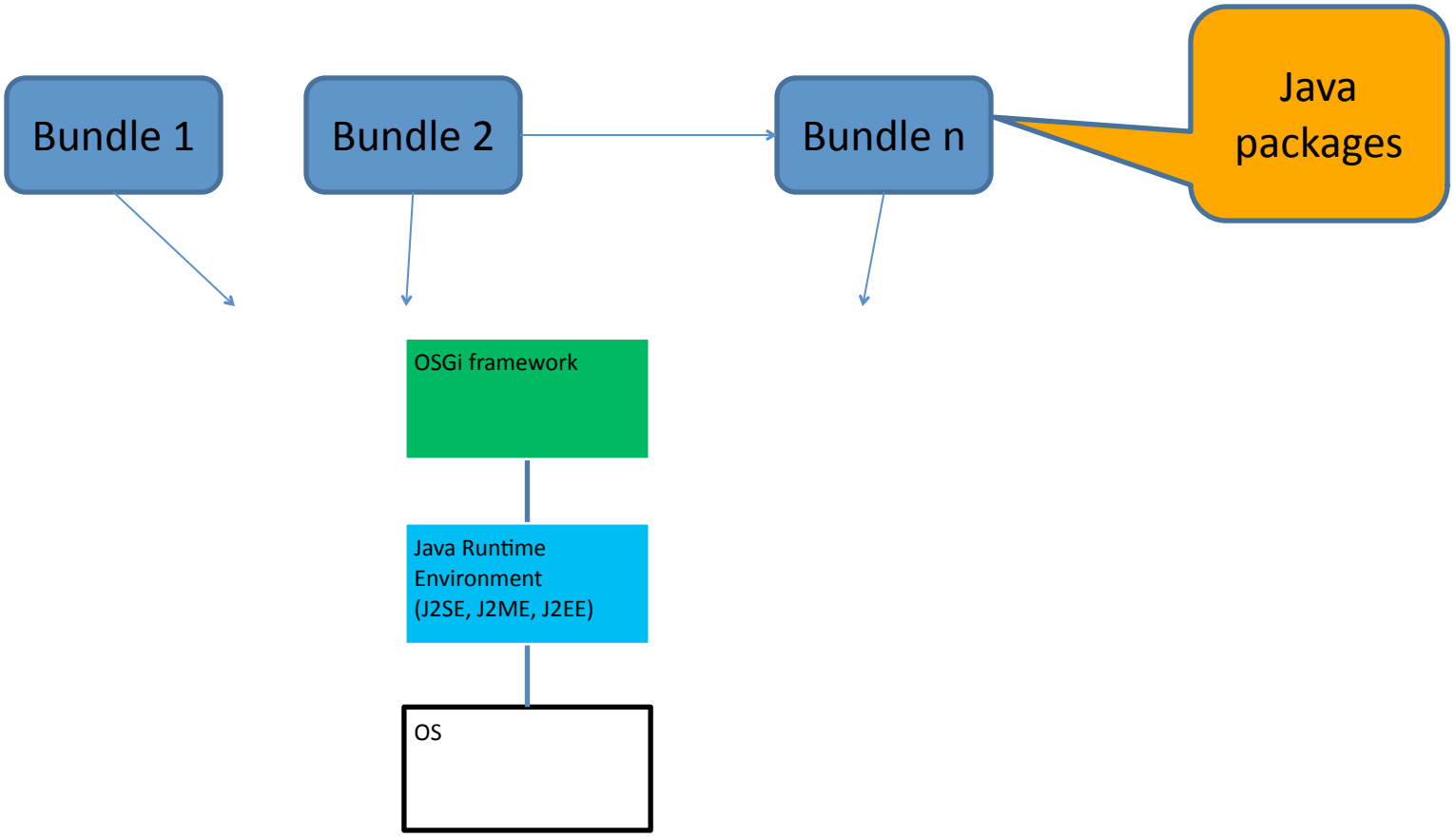
A PROGRAMMER'S PERSPECTIVE

Eclipse, OSGi as an integration platform

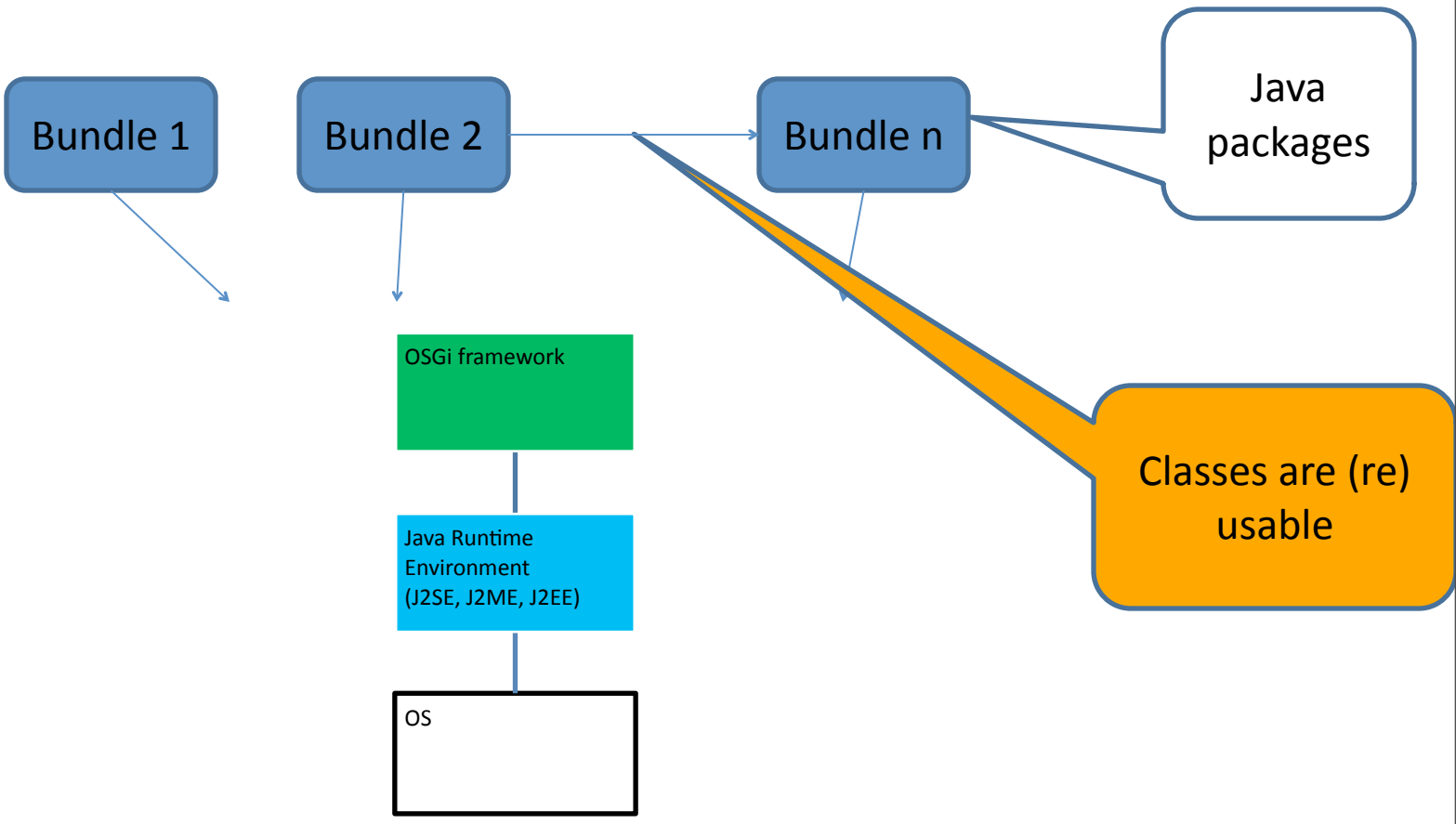
- OSGi = Open Services Gateway Initiative



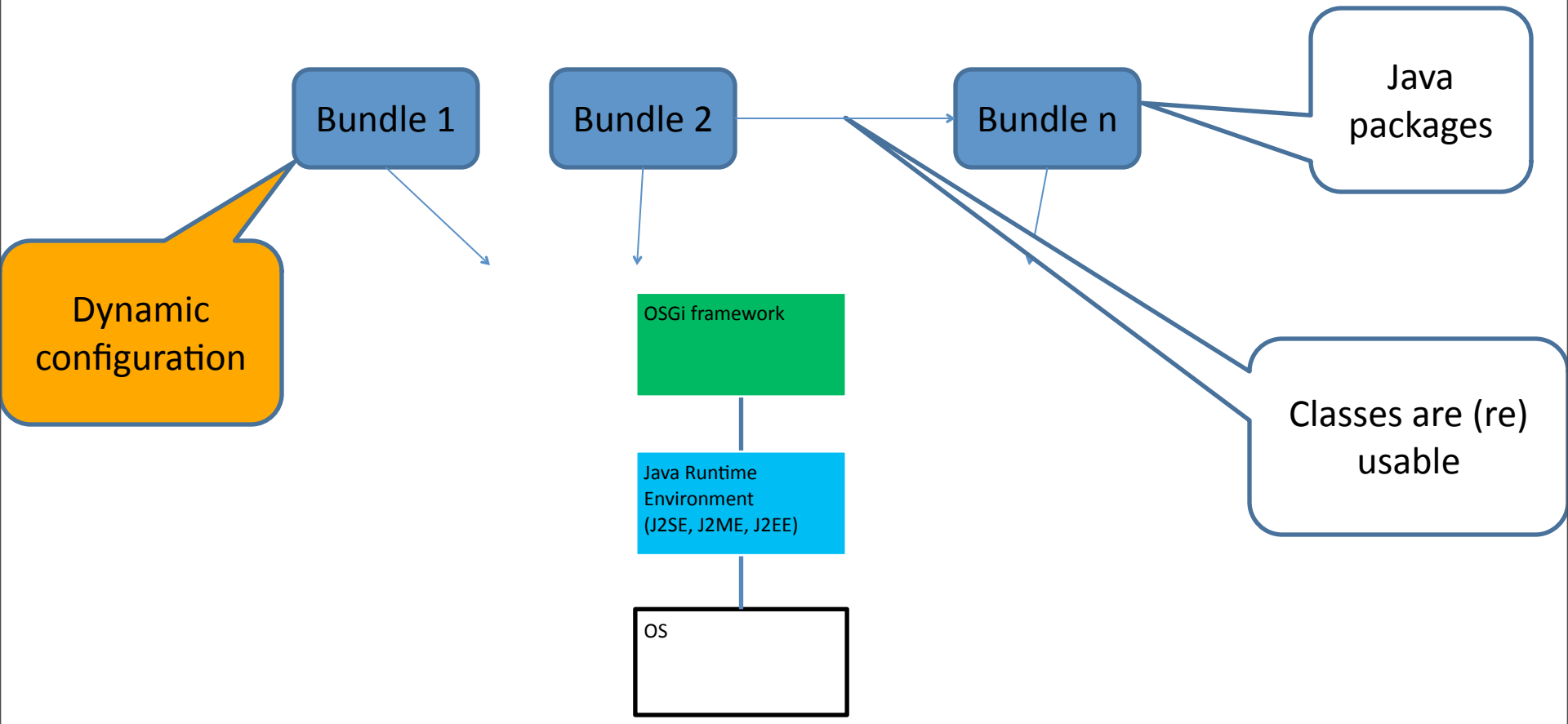
Eclipse, OSGi as an integration platform



Eclipse, OSGi as an integration platform

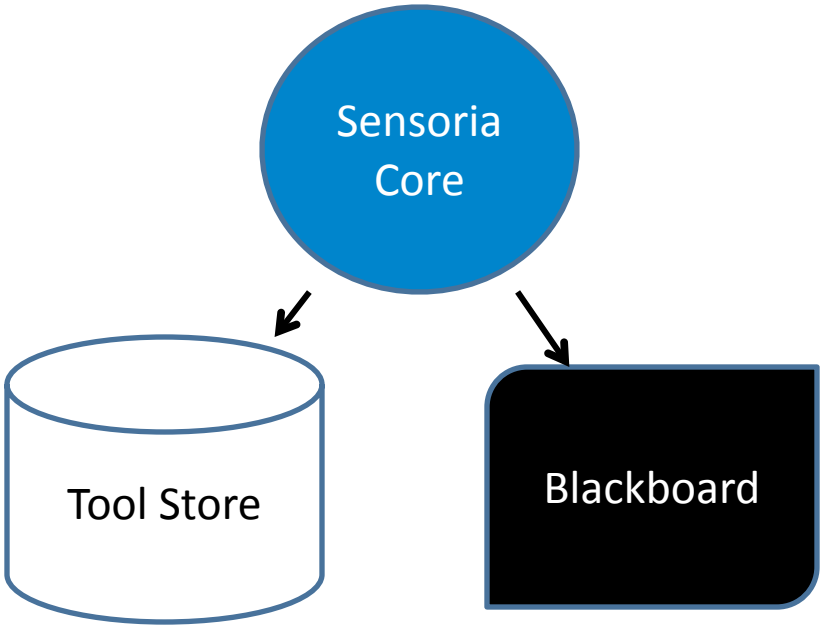


Eclipse, OSGi as an integration platform

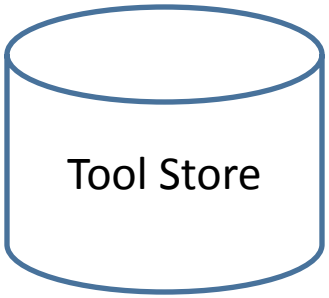


Sensoria

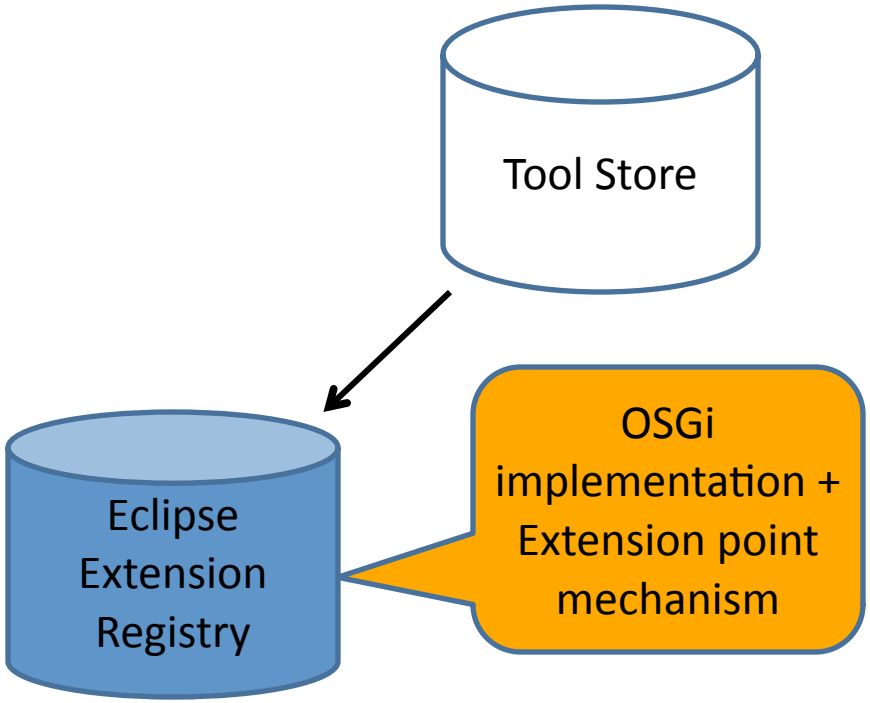
- OSGi bundles, and an Eclipse UI
- Provides basic infrastructure for OSGi-based tool and service integration



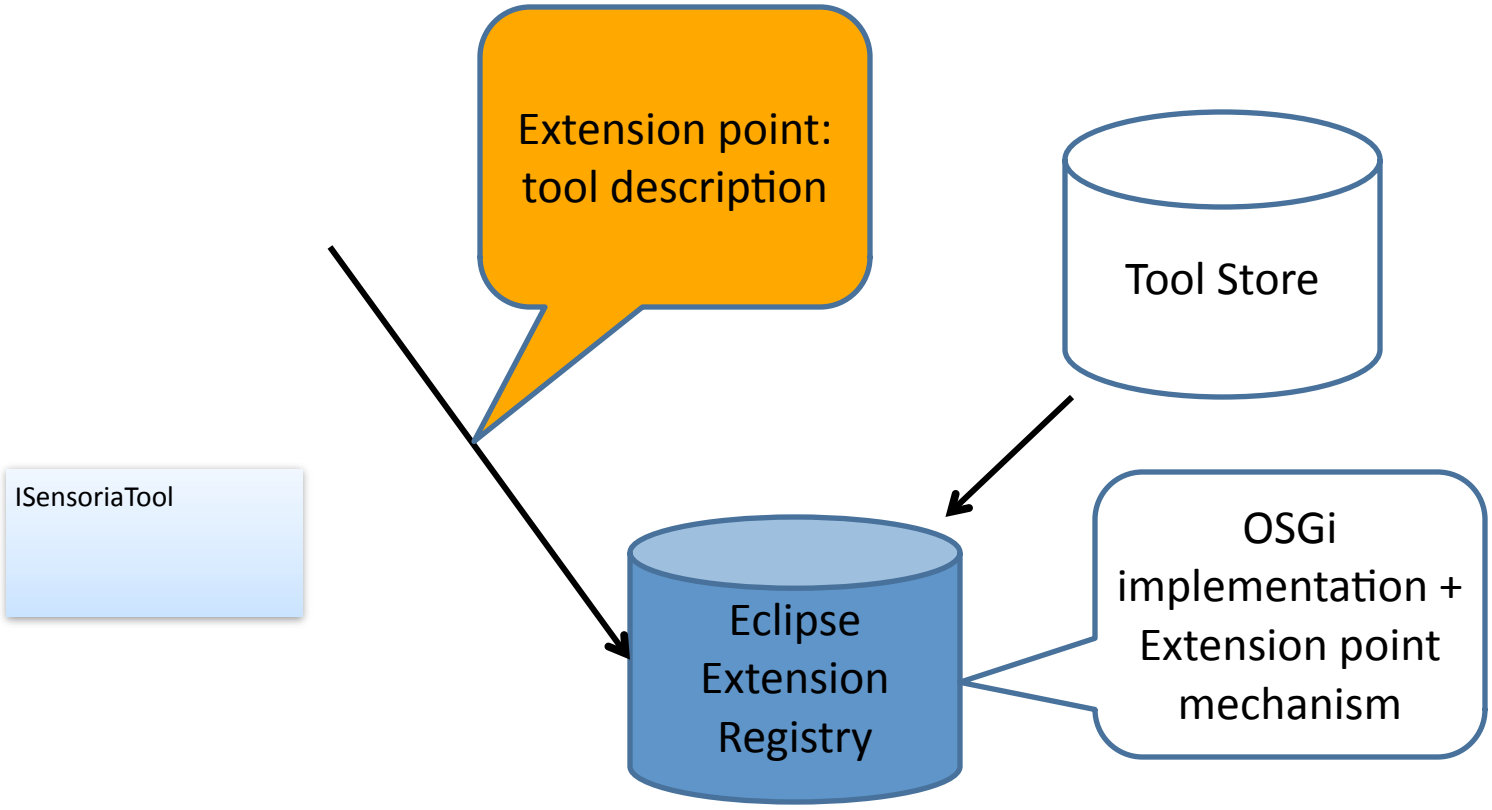
Sensoria



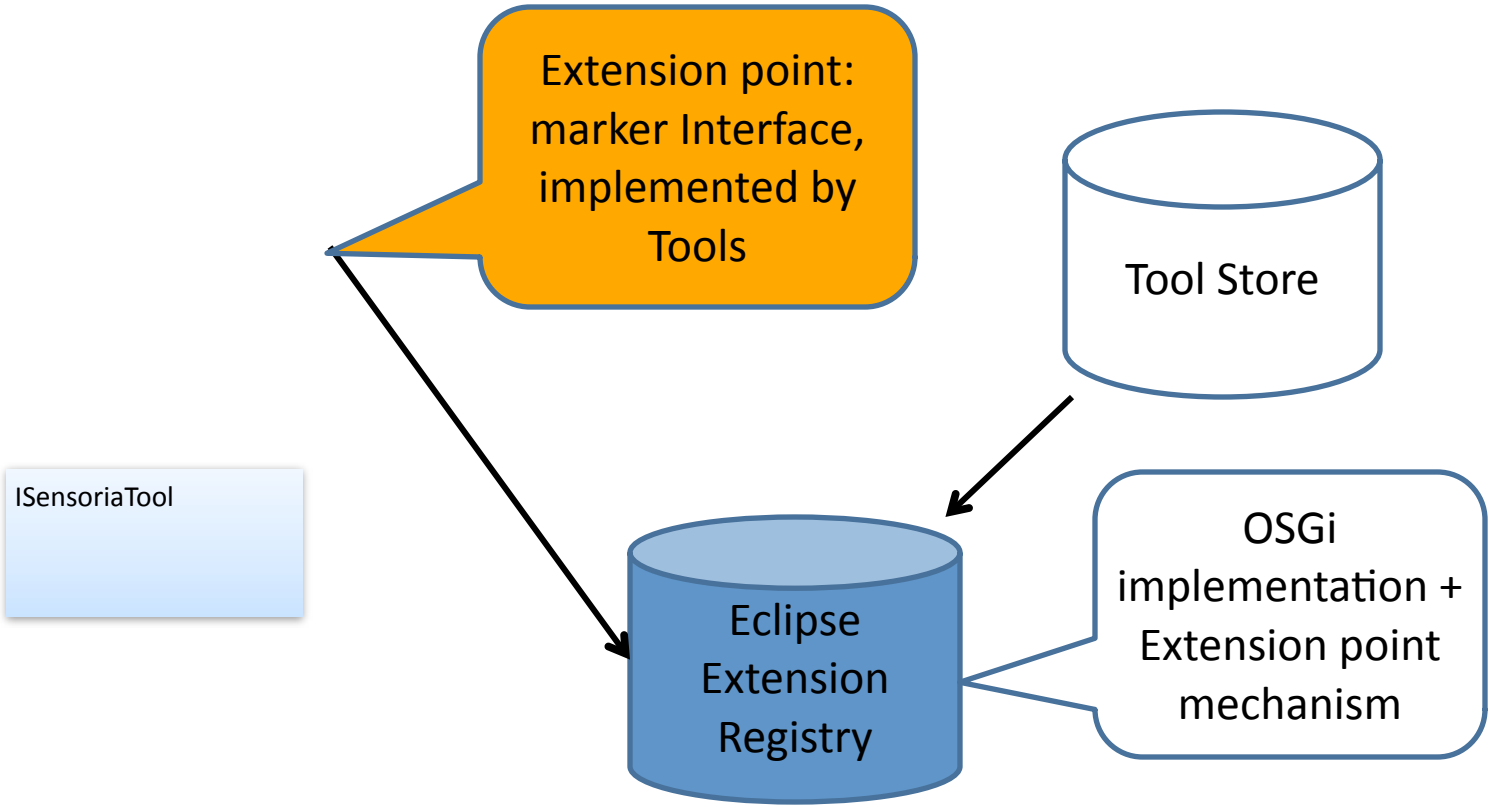
Sensoria


Tool Store
Eclipse Extension Registry
OSGi implementation + Extension point mechanism

Sensoria


Extension point:
tool description
Tool Store
ISensoriaTool
Eclipse
Extension
Registry
OSGi
implementation +
Extension point
mechanism

Sensoria


Extension point: marker Interface, implemented by Tools
Tool Store
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Eclipse Extension Registry
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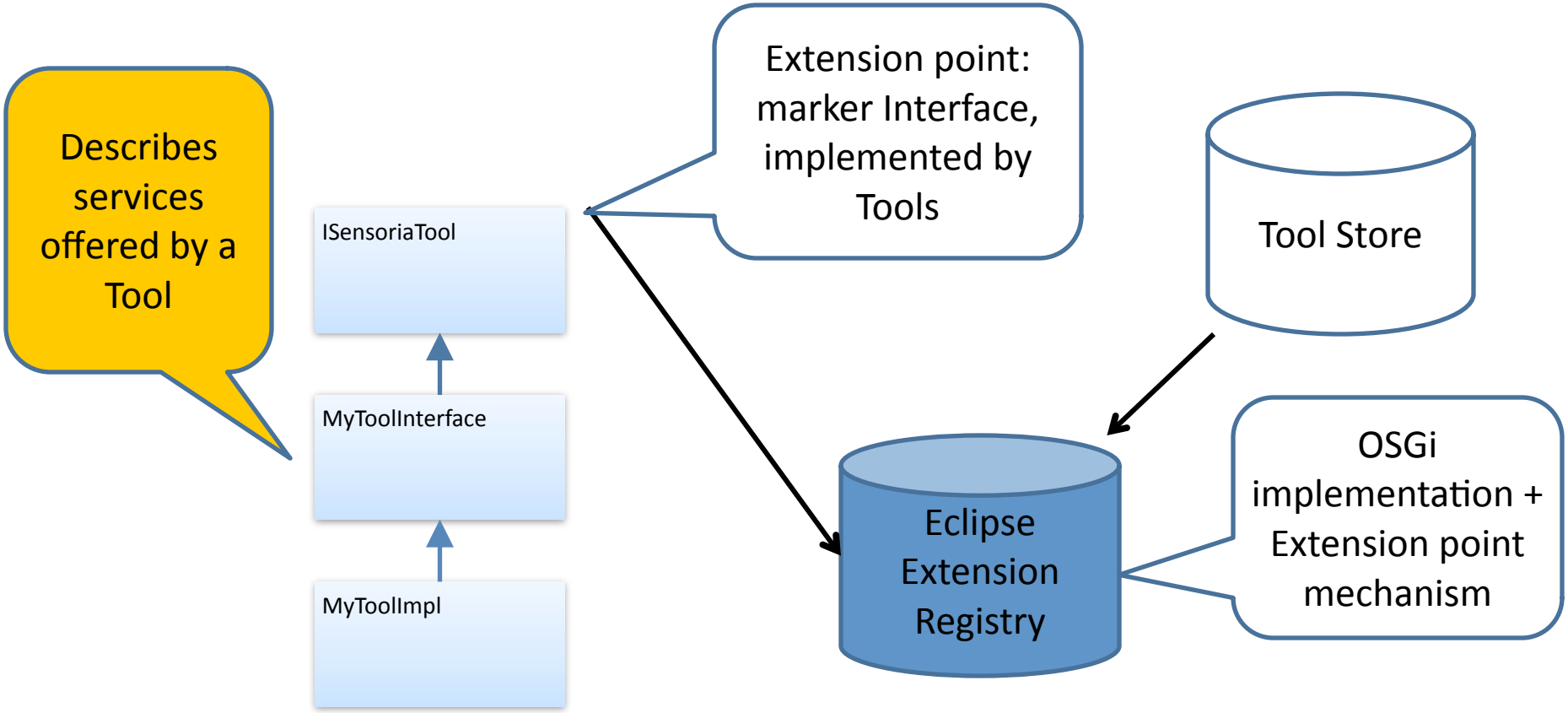
Describes services offered by a Tool
ISensoriaTool
MyToolInterface
MyToolImpl
Extension point: marker Interface, implemented by Tools
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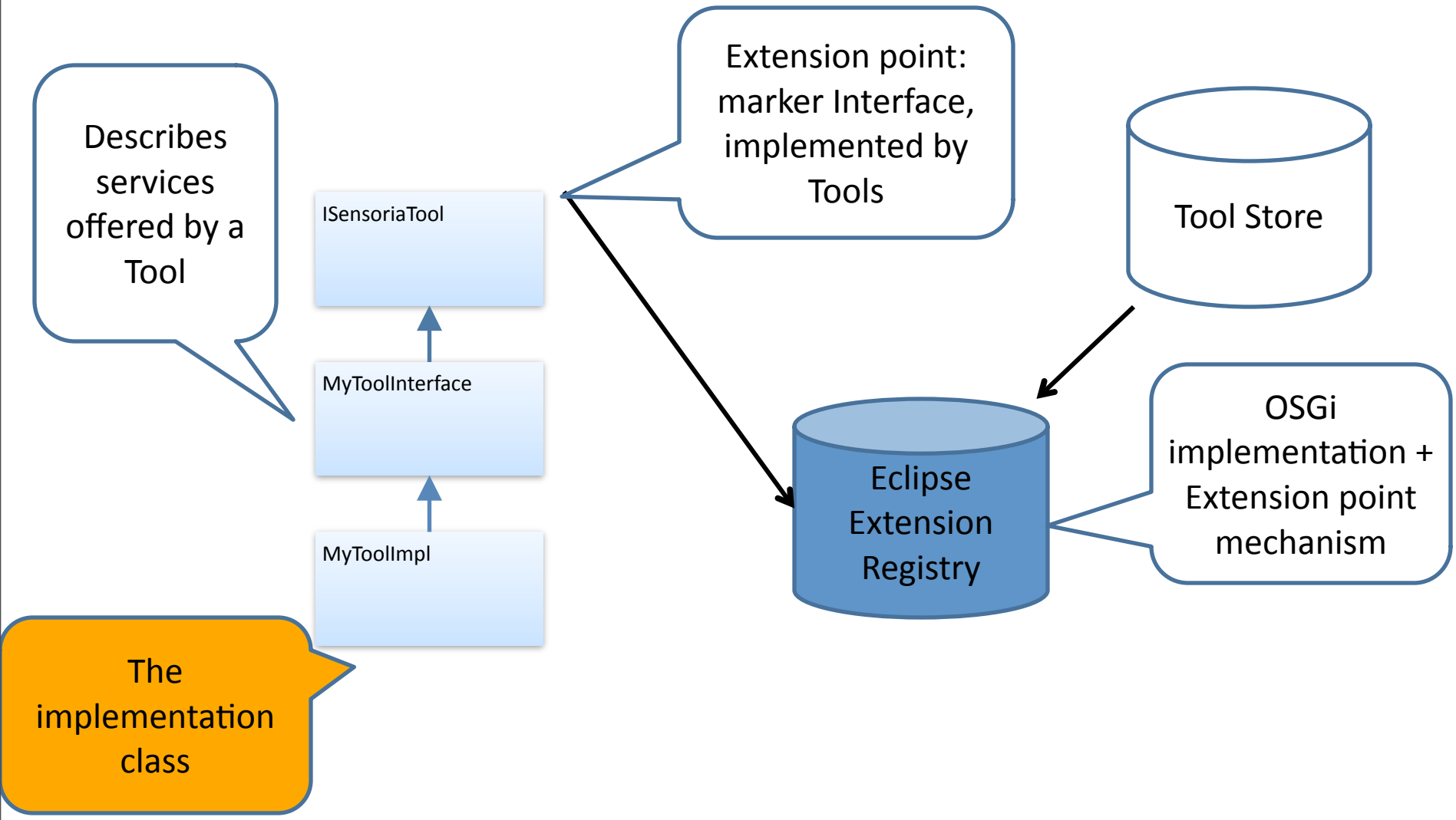
OSGi implementation + Extension point mechanism

Sensoria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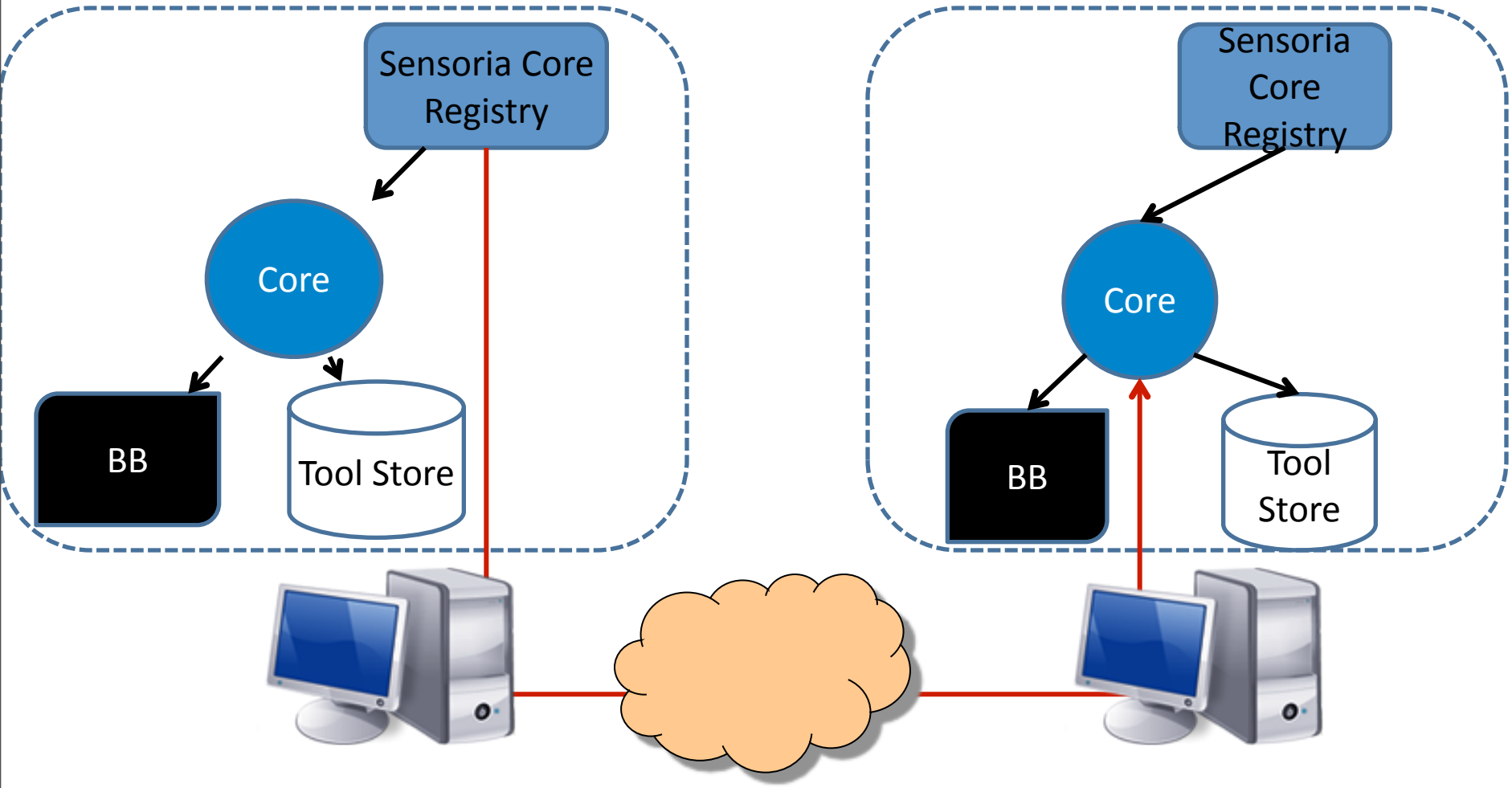
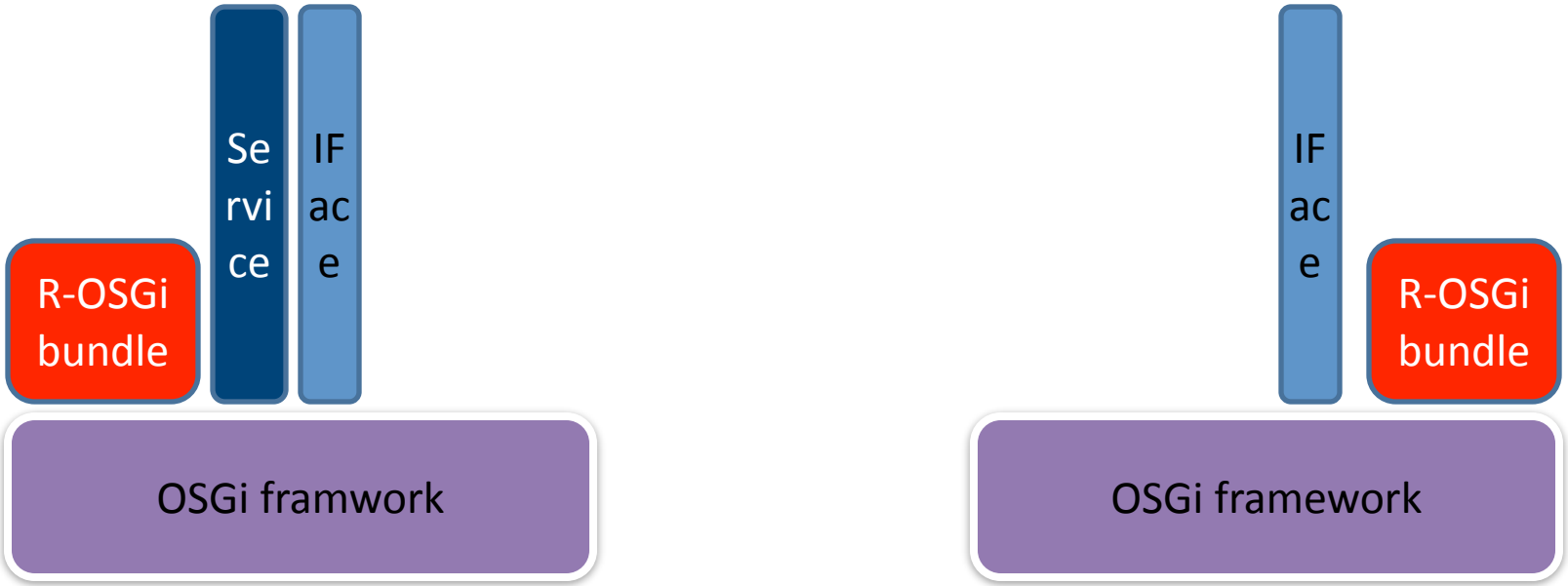
MyToolImpl
The implementation class

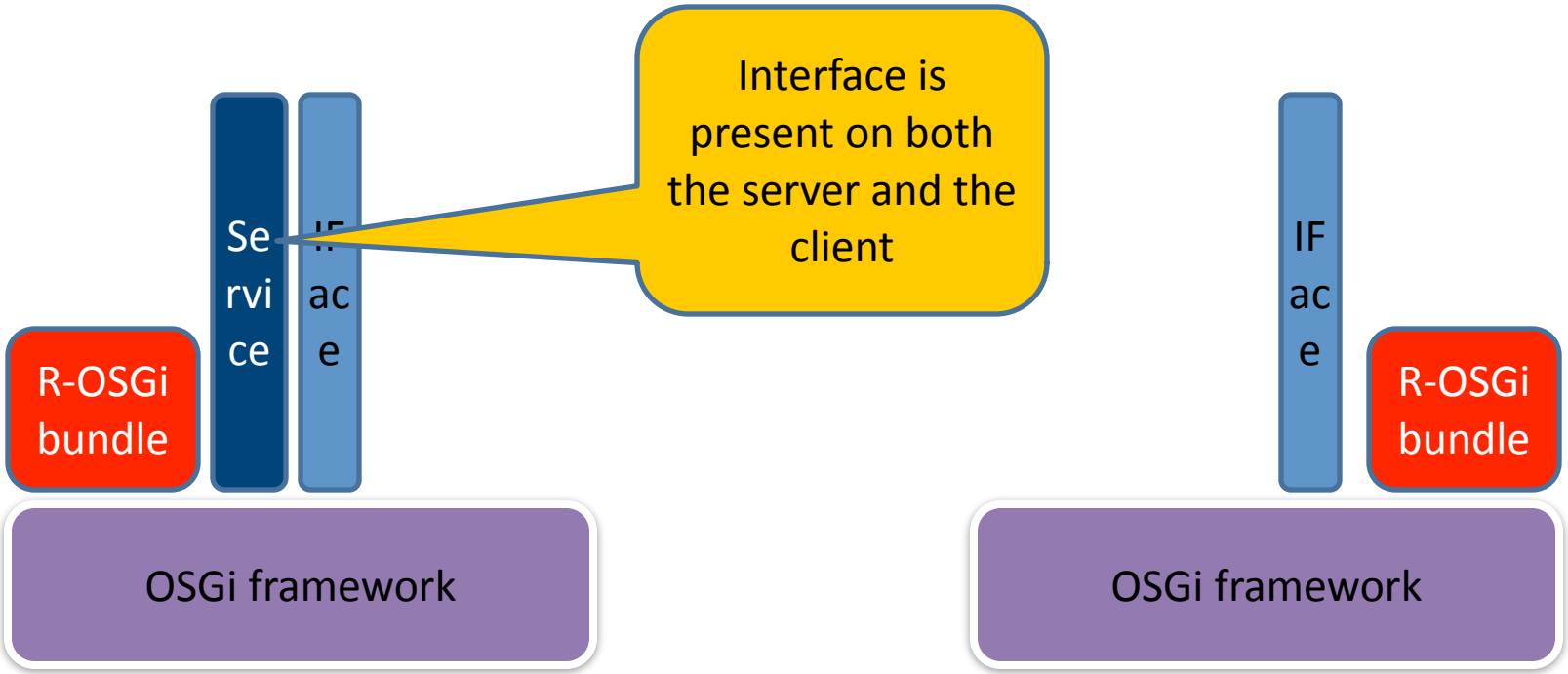
Distributed operation



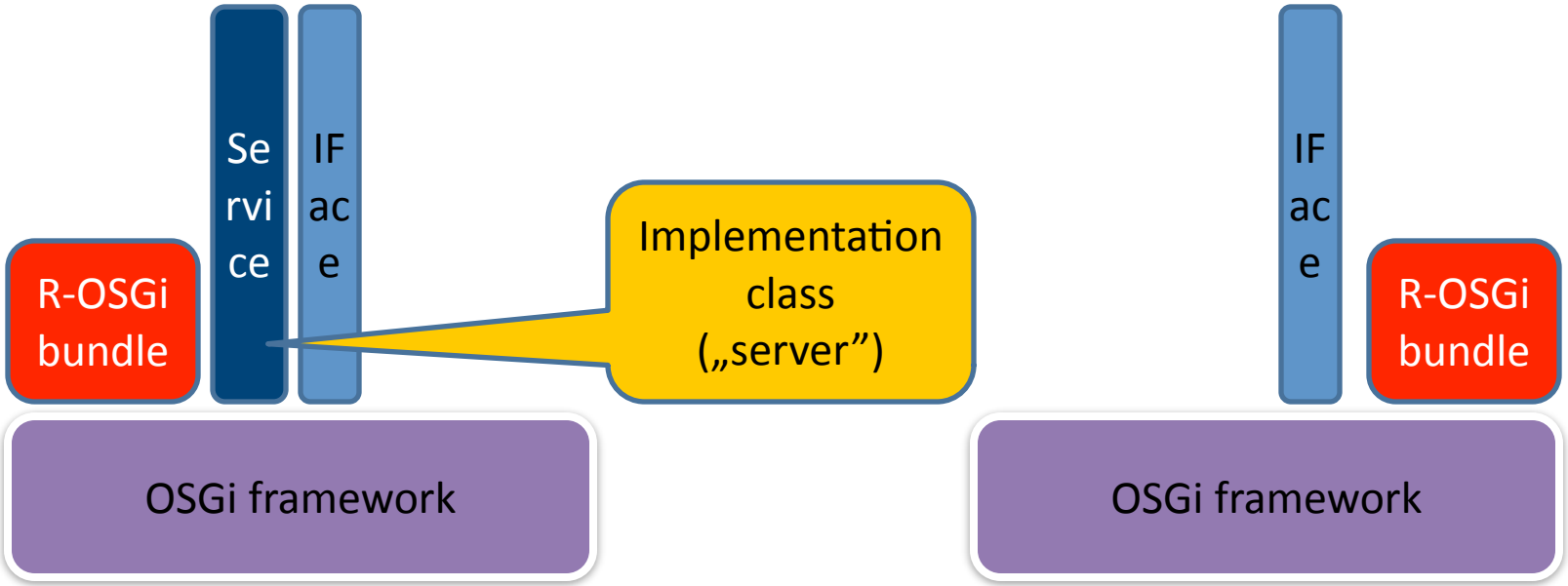
Remote OSGi (R-OSGi)



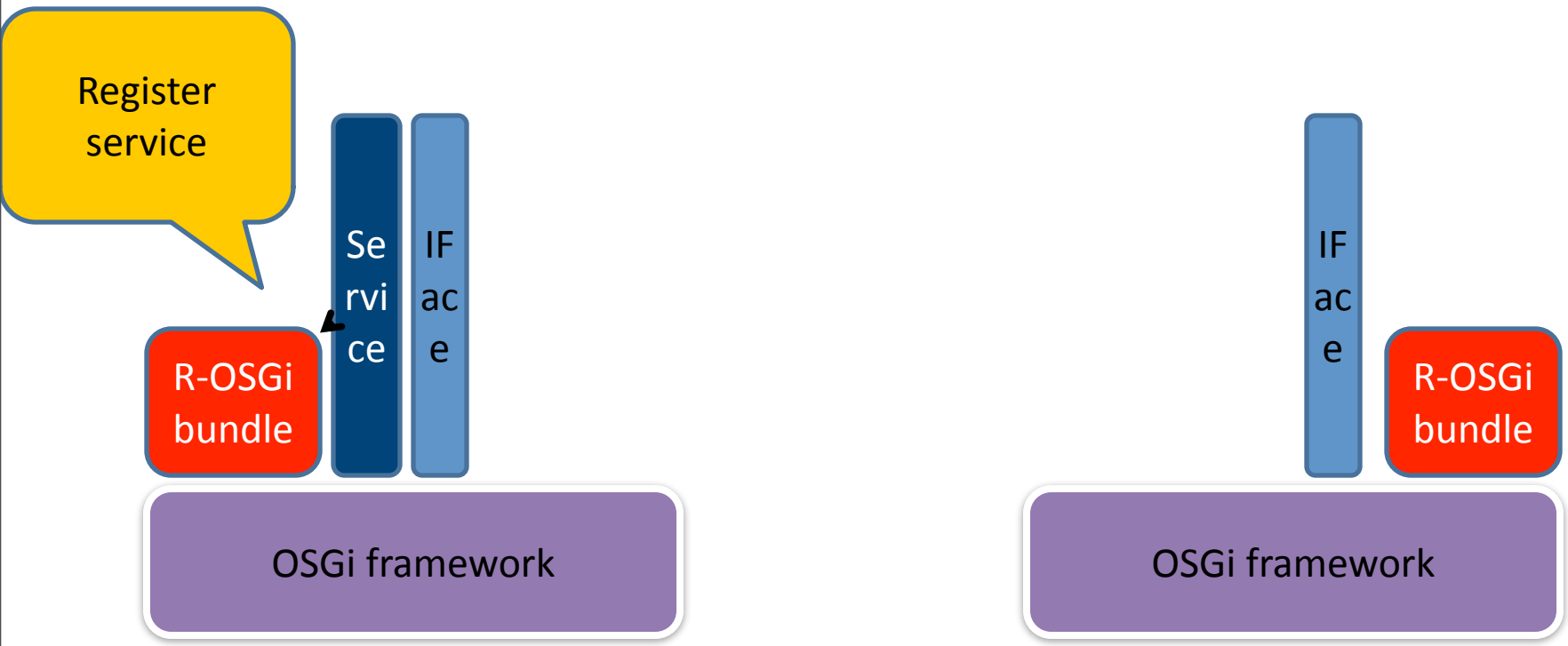
Remote OSGi (R-OSGi)



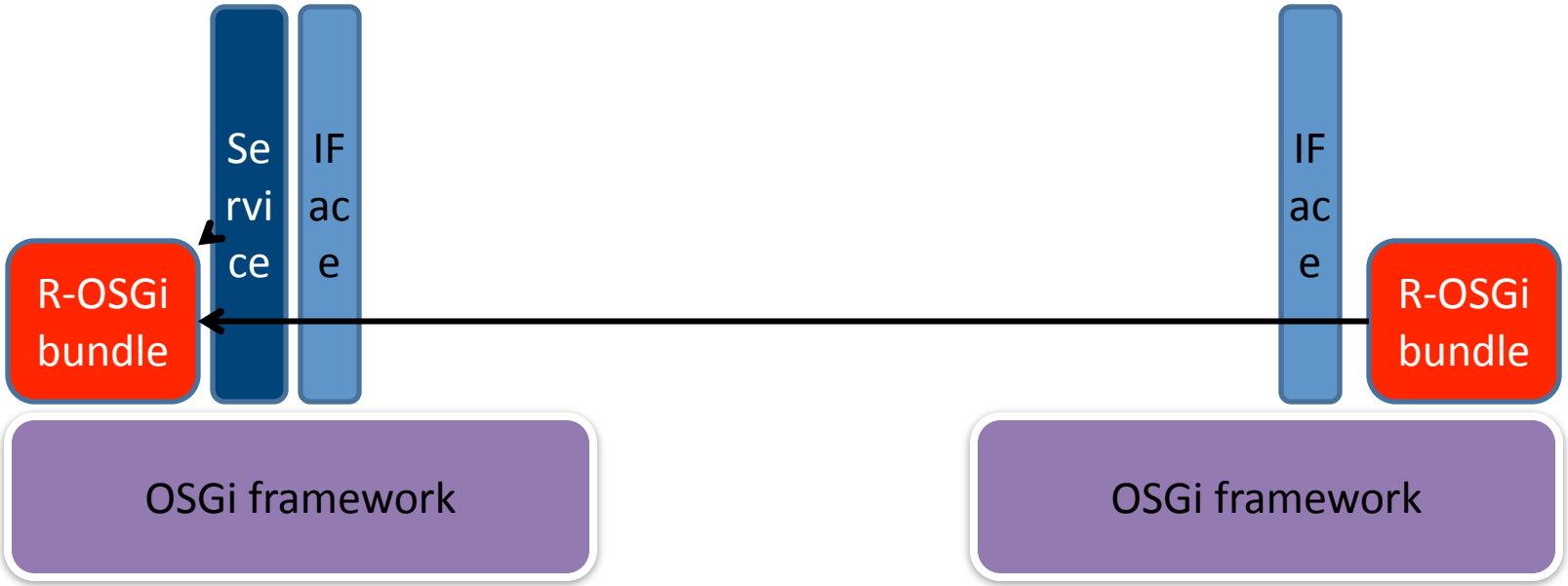
Remote OSGi (R-OSGi)



Remote OSGi (R-OSGi)

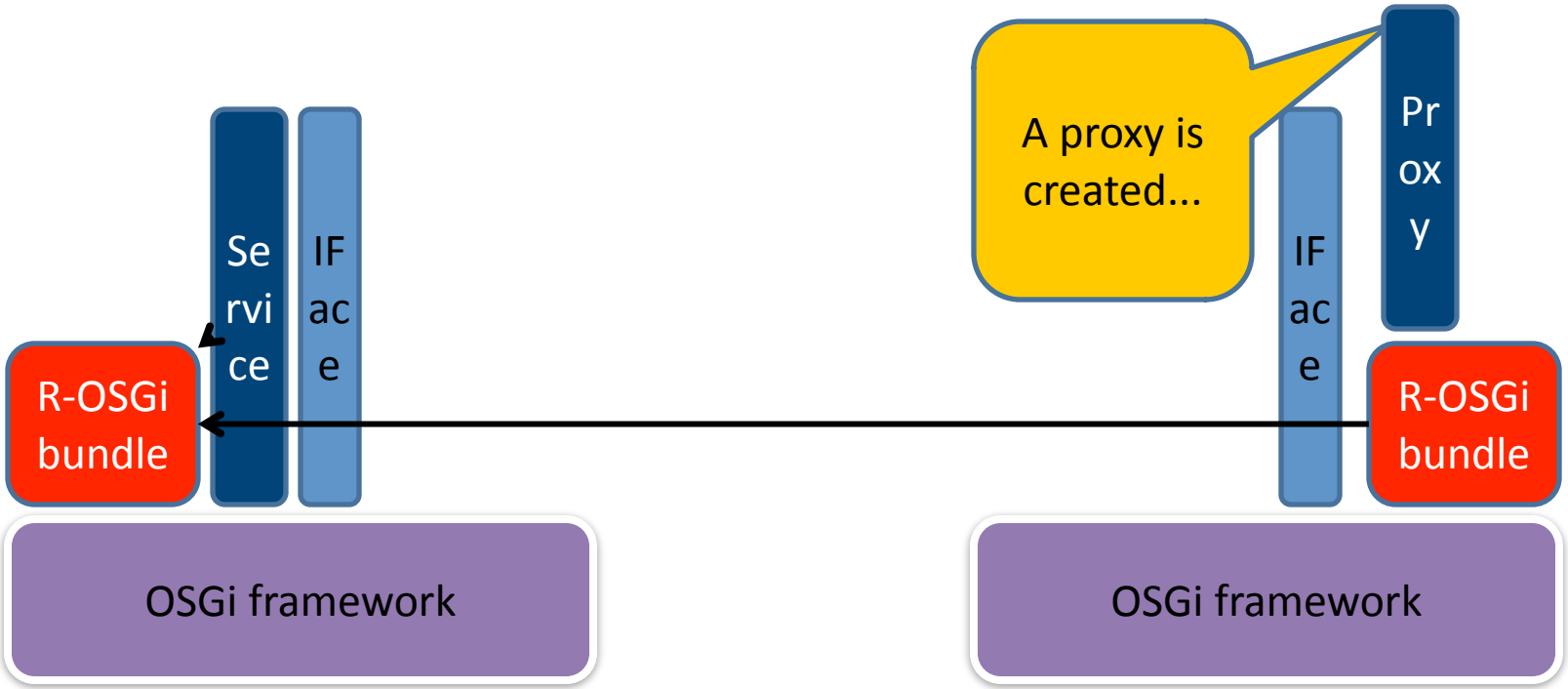


Remote OSGi (R-OSGi)

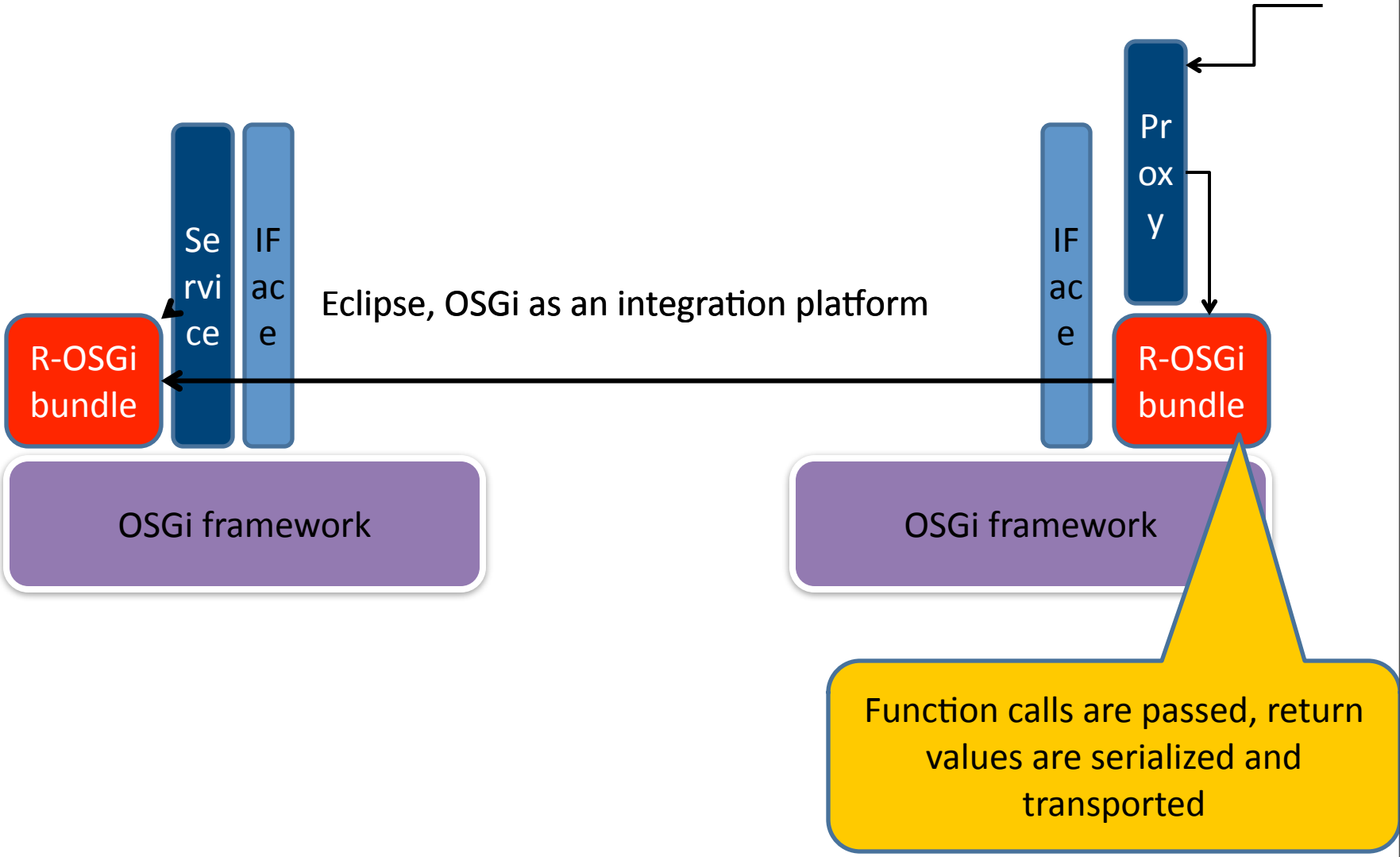


A remote client requests the service...

Remote OSGi (R-OSGi)



Remote OSGi (R-OSGi)



Comparing ECF and R-OSGi

- ECF
  - – - More complex architecture
  - – + More features (asynchronous calls, timing service, stb.)
- R-OSGi
  - + Simple
  - + Lightweight (only depends on OSGi)
  - Better suited for our goals

Workflow orchestration – Hello world

```
cReg.addRemoteCore("r-osgi://localhost:9278");

remoteCore = cReg.findCoreByName("r-osgi://localhost:9278");

testTool = remoteCore.findToolById("hu.bme.test.htmlconverter");

testIf = testTool.getServiceInterface();

sCore.print(testIf.htmlEscape("<<"));
```

Tool scripts

```
function soa2wsdl(umlFileName, outputDirectory)
{
  viatra = sCore.findToolByName("Viatra").getServiceInterface();
  vU = sCore.findToolByName("vUtil").getServiceInterface();
  fw = viatra.createFramework();

  vpml =   vU.getInputStream(vU.getFileFromBundle
("hu.bme.mit.viatra.integration.sensoria","model/
uml2soa_clean.vpml"));
       umlmodel_file = vU.getFile(umlFileName);
  viatra.nativeImportFromFile(fw,umlmodel_file,"uml");

  result =     viatra.runTransformation
(fw,"transformations.uml2soa2wsdl","Model=uml2.models."+umlmodel
+"_uml");
  viatra.writeoutput(fw,...);
  viatra.disposeFramework(fw);
}
```

Outlooks

- Support a proper workflow orchestration engine instead of the built-in JS interpreter
  - Parallelism
  - Exception handling
  - Asynchronous messages
- UI integration
  - Allow for user interaction in automated workflows

Where to get it?

- General info:
  - http://www.sensoria-ist.eu/
- SDE:
  - http://svn.pst.ifi.lmu.de/trac/sct