Model-Driven Development with the jABC

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jABC Framework

- A modelling tool for service-oriented design
- Predecessors range back to 1995
- Used in several industrial projects
  - Intelligent Networks
  - Web-based distributed decision support systems
  - Test automation environments

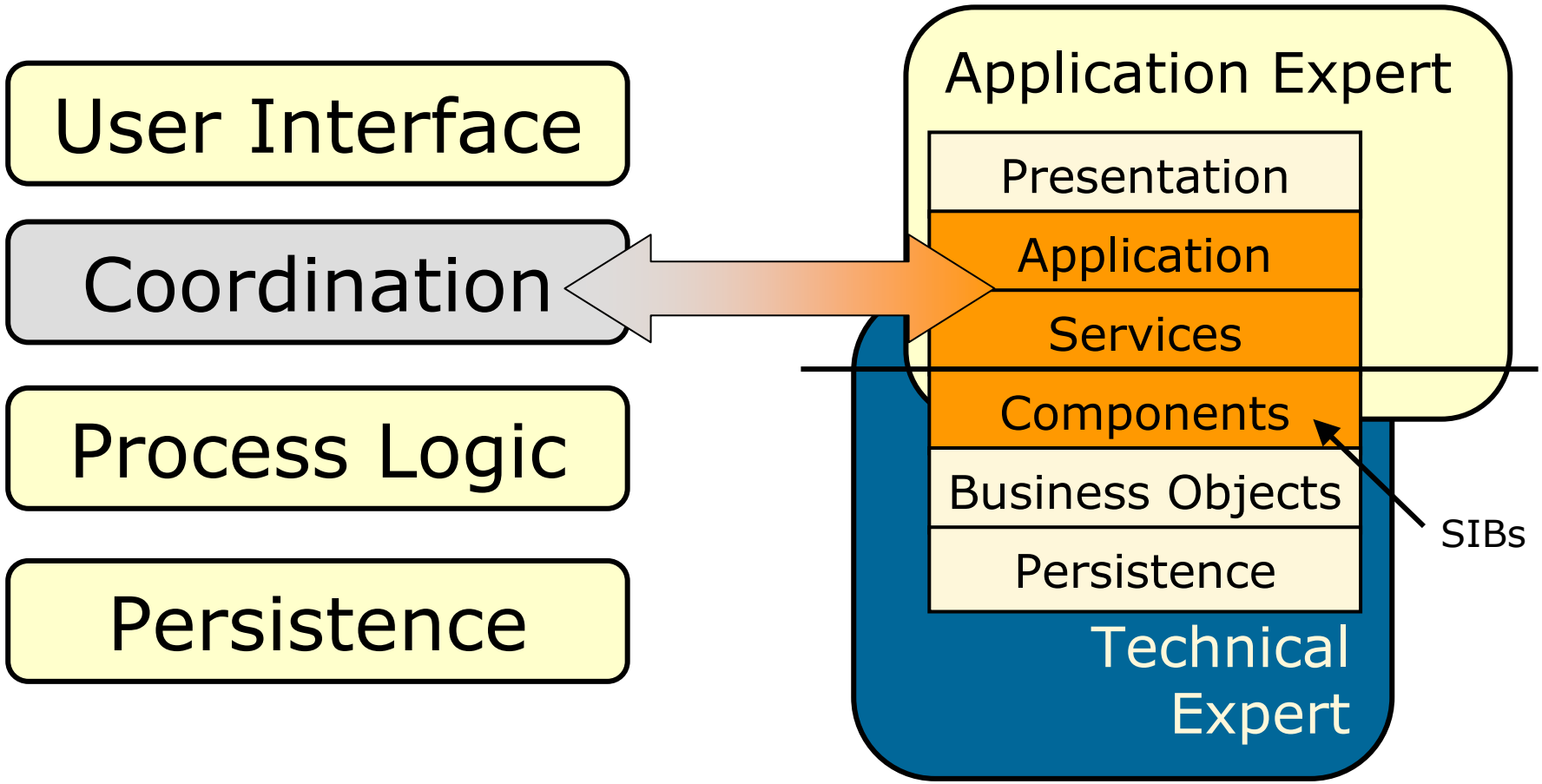
jABC Key Features

- Simplicity
- Agility
- Customisability
- Consistency
- Verification
- Service orientation
- Executability
- Universality

Feature-oriented Description

1. Feature-oriented service description:
   base system and *optional features*
2. Feature and system behaviour:
   specified as *Service Logic Graphs* (SLGs)
3. SLGs are realized using a library of reusable
   Service-Independent Building Blocks (SIBs)
4. Description also includes abstract requirements
5. Temporal logic *constraints* regulate *interactions*
   between features
6. Feature compositions are allowed if no
   constraints are violated

jABC Architecture



Service-Independent Building Blocks (SIBs)

- Are nodes in the Service Logic Graphs
- Outgoing branches are chosen according to the result of execution
- Placeholders for future functionality can be automatically generated
- Self-documentation options
- Hierarchy via *GraphSIBs*
- May be as simple as making a library call
- May even alter the control flow

The structure of SIBs (1)

- SIBs are self-contained Java classes
- Name is the Java class name
- Parameters are the public fields
- Branches are reserved public fields

```
1  import de.metaframe.jabc.framework.sib.annotation.SIBClass;
2
3  @SIBClass("20861480163021731e729e8f:c8fed88d54c0:6d1c73a9d71047059ea61b")
4  public class Example {
5
6      public int counter = 0;
7      public int value = 1;
8
9      public static final String[] BRANCHES = { "fix1", "fix2" };
10     public String[] branches = { "var1", "var2" };
11
12     public Example() {
13         // SIB Constructor
14     }
15
16 }
```

The structure of SIBs (2)

- SIBs may provide documentation (and an icon)

```
1  import de.metaframe.jabc.framework.sib.DocType;
2  import de.metaframe.jabc.framework.sib.annotation.SIBClass;
3
4  @SIBClass("20861480163021731e729e8f:c8fed88d54c0:6d1c73a9d71047059ea61b")
5  public class Example {
6
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11     public String[] branches = { "var1", "var2" };
12
13     public Example() {
14         // SIB Constructor
15     }
16
17     public String getDocumentation(DocType category, String param) {
18         if(category.equals(DocType.SIB))
19             return "A demo SIB.";
20         else
21             return null;
22     }
23
24 }
```
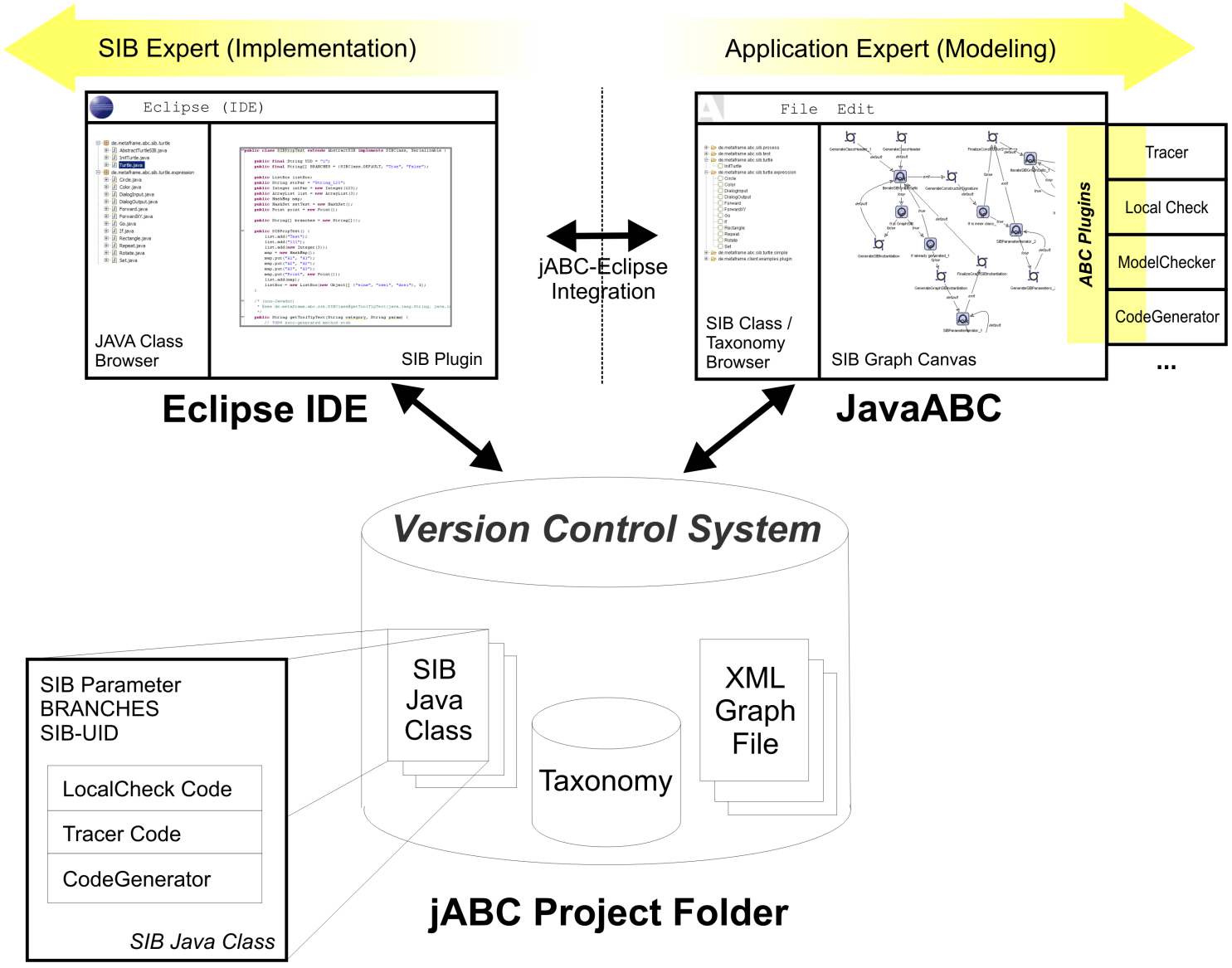
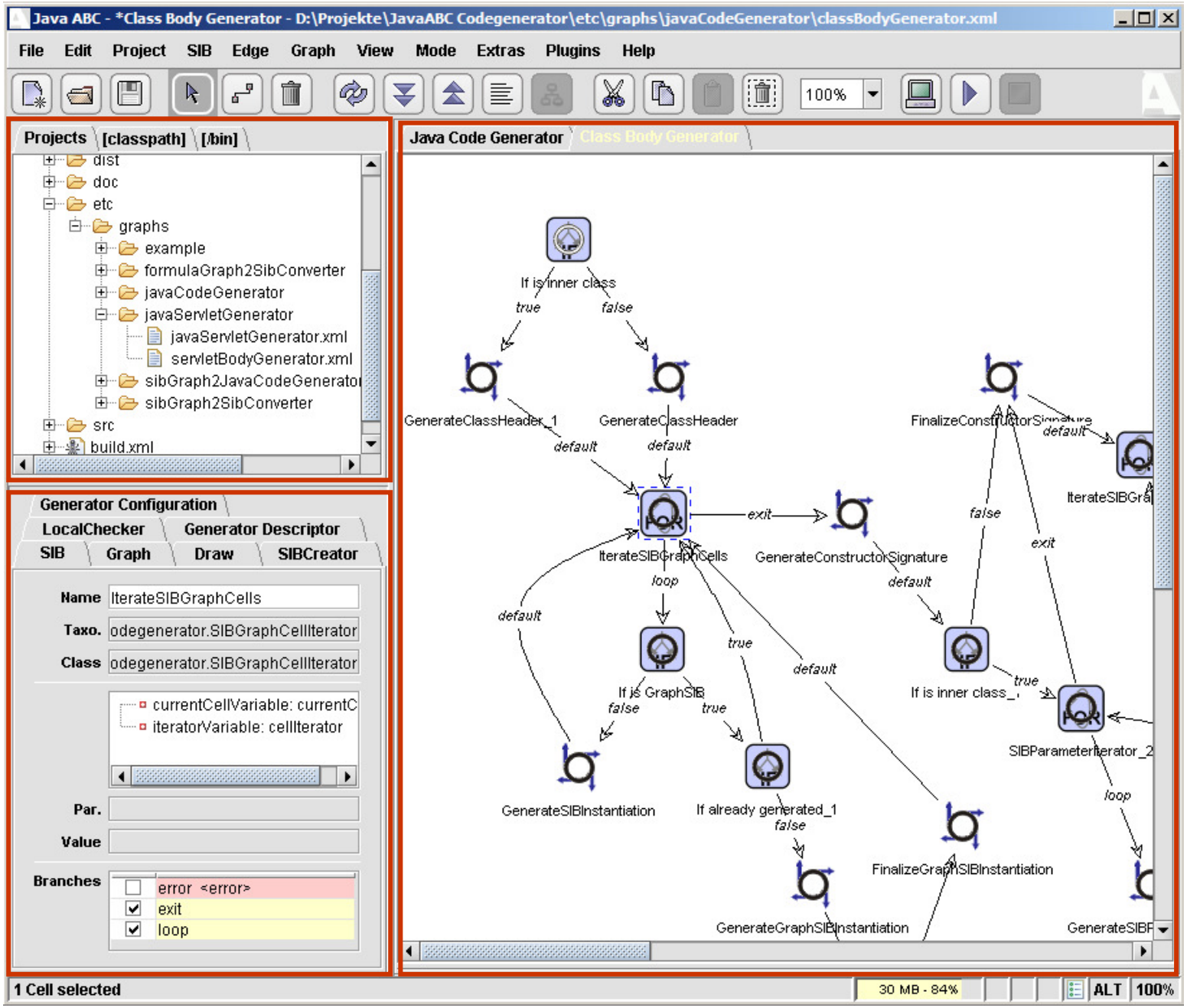

```java
import de.metaframe.abc.sib.Executable;
import de.metaframe.jabc.framework.execution.ExecutionEnvironment;
import de.metaframe.jabc.framework.sib.DocType;
import de.metaframe.jabc.framework.sib.annotation.SIBClass;

@SIBClass("208614801630217316729e8f:c8fed88d54c0:6d1c73a9d71047059ea61b")
public class Example implements Executable {

    public int counter = 0;
    public int value = 1;

    public static final String[] BRANCHES = { "fix1", "fix2" };
    public String[] branches = { "var1", "var2" };

    public Example() {
        // SIB Constructor
    }

    public String getDocumentation(DocType category, String param) {
        if(category.equals(DocType.SIB))
            return "A demo SIB.";
        else
            return null;
    }

    public String trace(ExecutionEnvironment env) {
        if (env.existsKey("branch"))
            return env.get("branch").toString();
        else
            return "fix1";
    }
}
```

SIB Taxonomies

- Users can specify their own taxonomies on the available SIB repository
- Dynamic arrangement into domain-specific SIB libraries
- No need to stick with the taxonomy given by the packages of the SIB Java classes

The Big Picture




Java ABC - *Class Body Generator - D:\Projekte\JavaABC Codegenerator\etc\graphs\javaCodeGenerator\classBodyGenerator.xml
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100%
Projects [classpath] [/bin]
dist
doc
etc
graphs
example
formulaGraph2SibConverter
javaCodeGenerator
javaServletGenerator
javaServletGenerator.xml
servletBodyGenerator.xml
sibGraph2JavaCodeGenerator
sibGraph2SibConverter
src
build.xml
Generator Configuration
LocalChecker Generator Descriptor
SIB Graph Draw SIBCreator
Name IterateSIBGraphCells
Taxo. odegenerator.SIBGraphCellIterator
Class odegenerator.SIBGraphCellIterator
currentCellVariable: currentC
iteratorVariable: cellIterator
Par.
Value
Branches
error <error>
exit
loop
Java Code Generator
Class Body Generator
If is inner class
true
false
GenerateClassHeader_1
GenerateClassHeader
default
IterateSIBGraphCells
exit
GenerateConstructorSignature
loop
If is GraphSIB
GenerateSIBInstantiation
If already generated_1
GenerateGraphSIBInstantiation
FinalizeGraphSIBInstantiation
If is inner class_1
SIBParameterIterator_2
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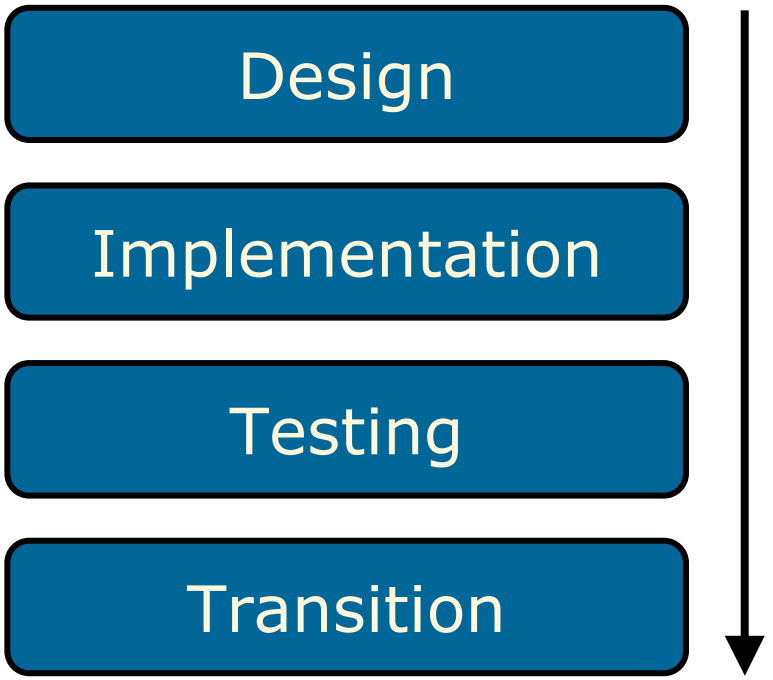
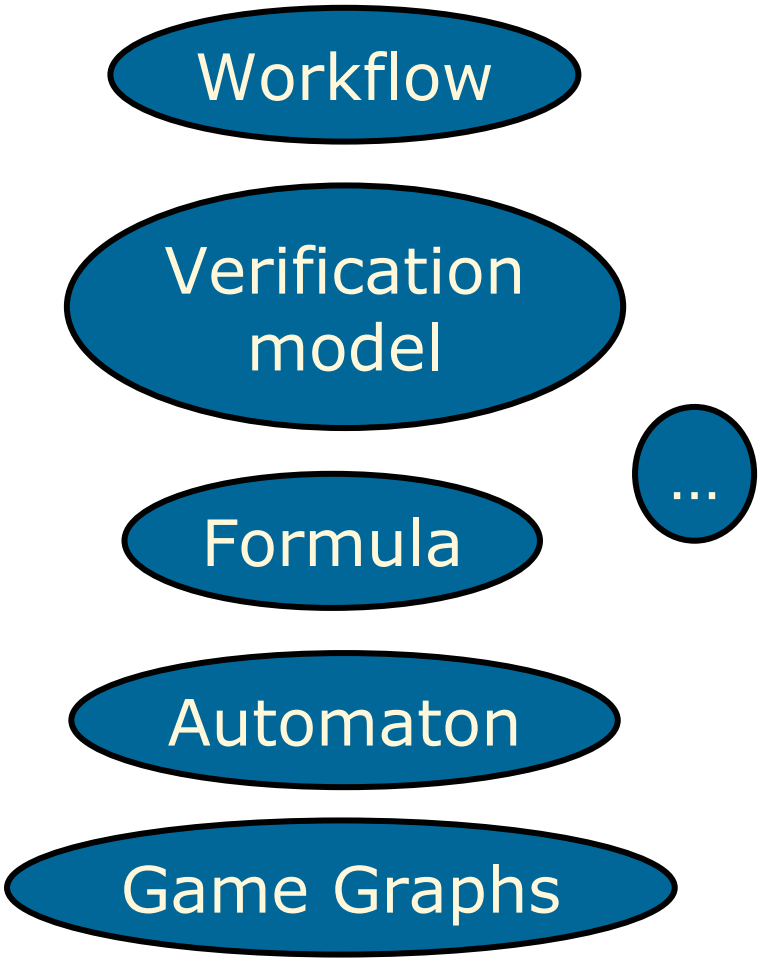
Model-Based Lifecycle Management (1)

- One tool for the *entire* development process

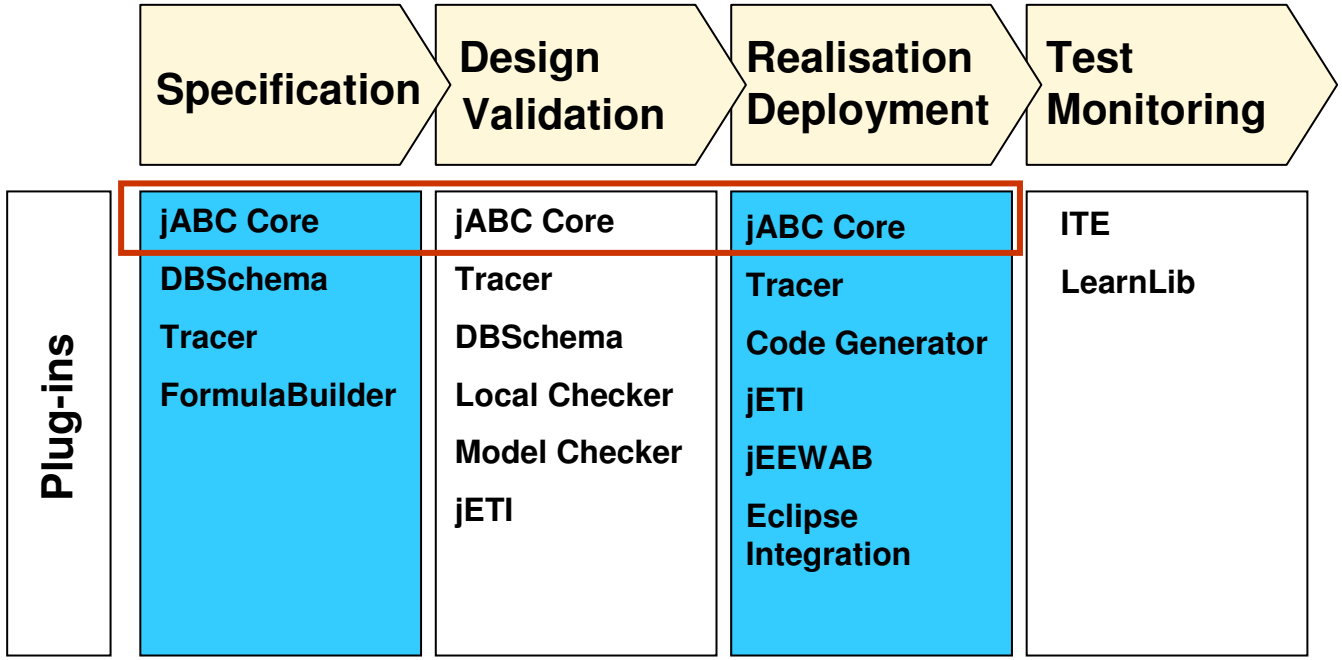


Model-Based Lifecycle Management (2)

- One tool for several interpretations of the same model via plug-ins



Model-Based Lifecycle Management (3)



Enriching the JavaABC functionality using plug-ins

- Flexible plug-in framework
- Example plug-ins include
  - Local and global model verification
  - Automaton generation
  - Visual modelling of formulas
  - Step-wise execution and debugging
  - Code generation
  - Database schema design

Plug-ins overview (1)

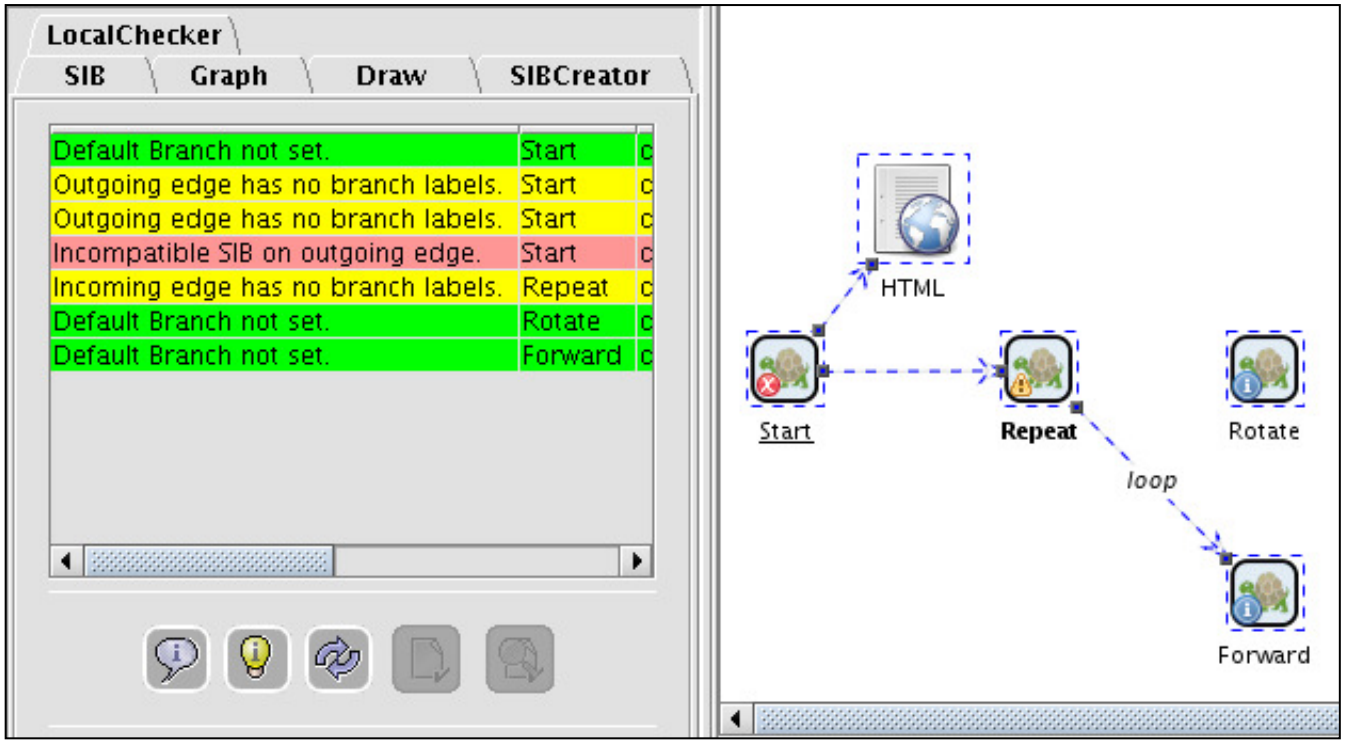
Plug-in	local	global	internal	interface
Bean Shell	X			X
Code Generator		X		X
FormulaBuilder		X		X
DBSchema		X		X
Docbook	X	X		X
Eclipse	X	X		X
GEAR		X	X	
jETI	X			X

Plug-ins overview (2)

Plug-in	local	global	internal	interface
JEEWAB		X		X
jMoSeL		X		X
LearnLib		X		X
LocalChecker	X		X	
SIBCreator	X			X
Taxonomy Editor	X		X	
Tracer	X	X	X	

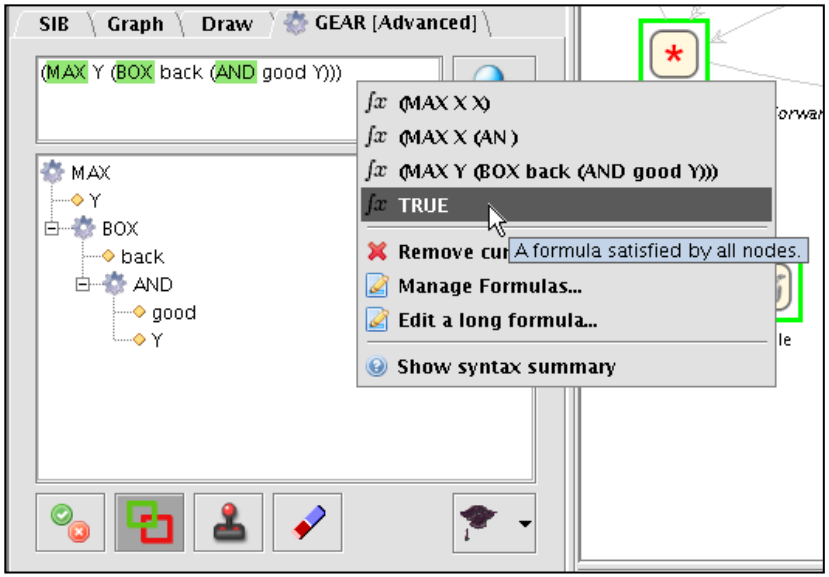
Local model verification

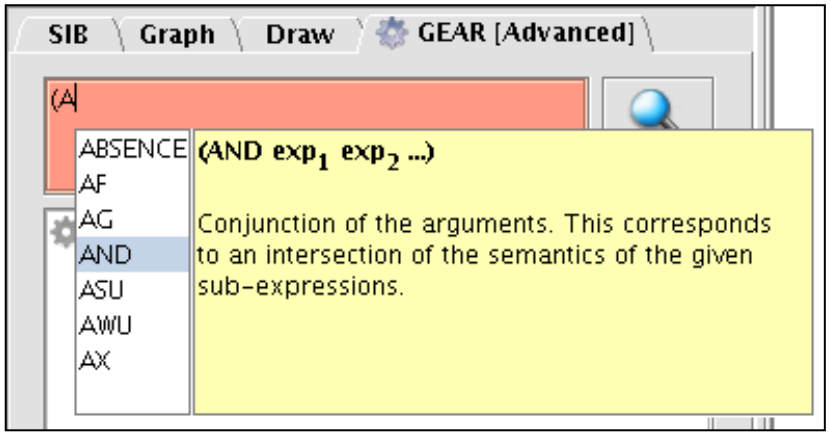
- **LocalChecker**
  run-time checking of SIB usage
- Java code written by the SIB expert



Global model verification

- **GEAR**
  Game-based model checker for the modal μ-calculus
- Rich macro mechanism to extend syntax and semantics
- Several views for different contexts





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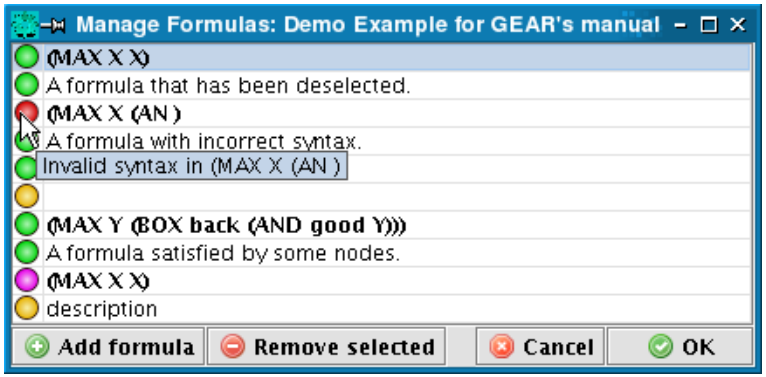
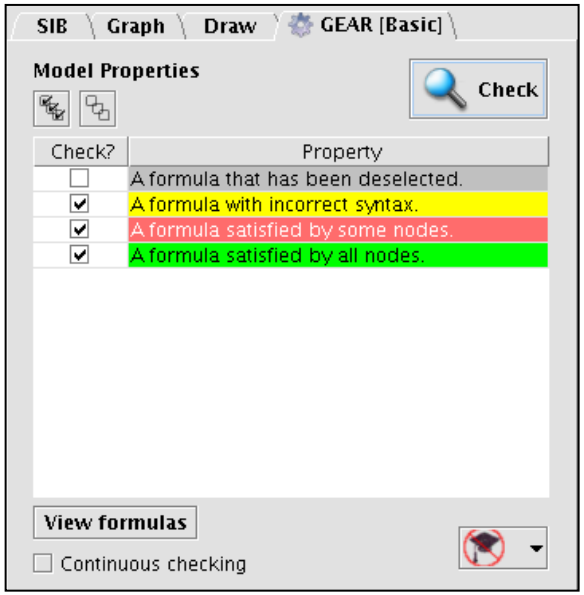
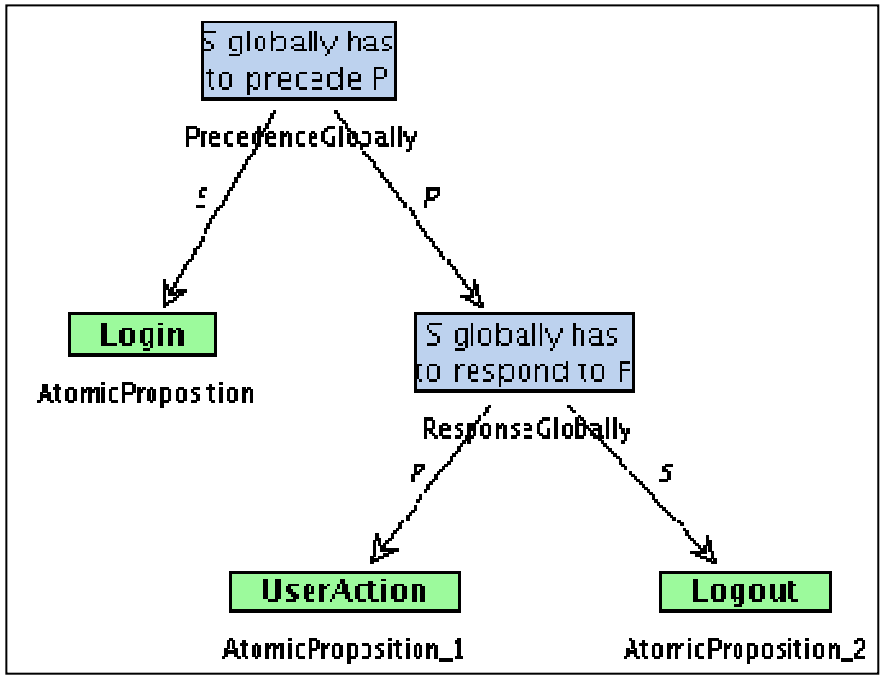




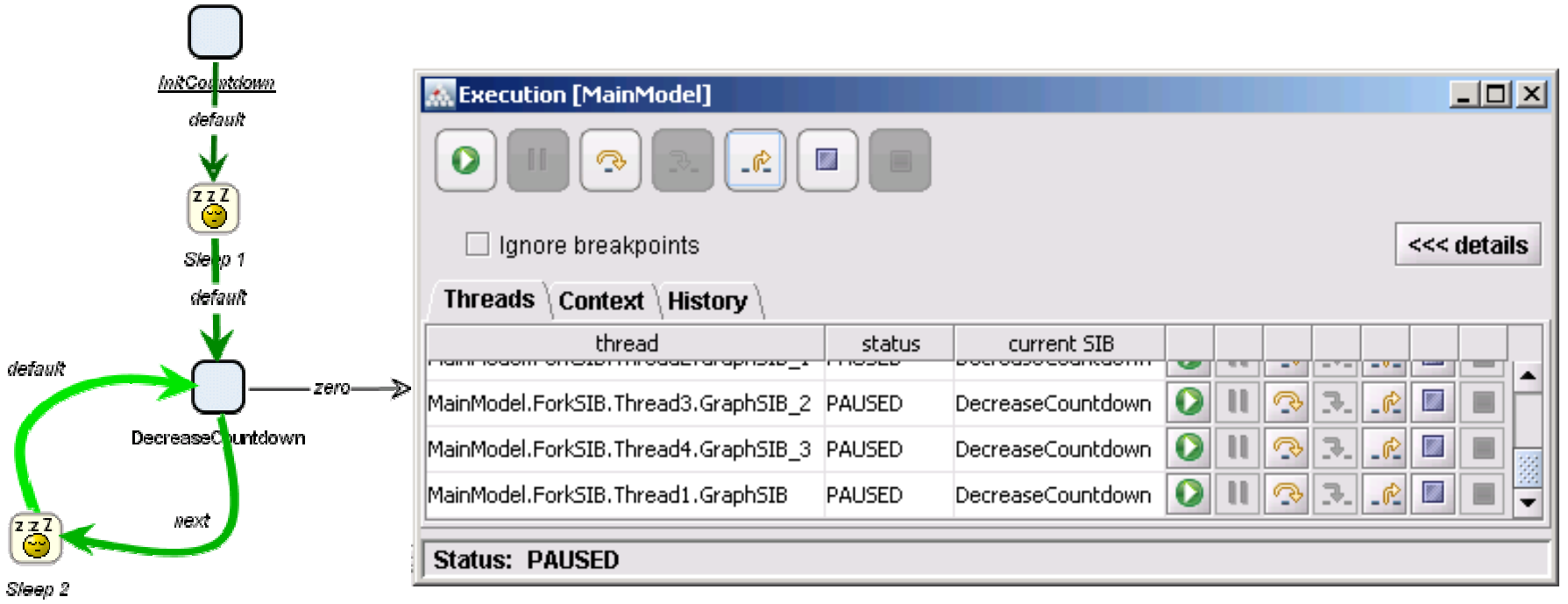
Visual modelling and generation of formulas

- **FormulaBuilder**
  Formula modelling and generation
- Export to pre-defined logic syntaxes, e.g. GEAR



Step-by-step execution and debugging

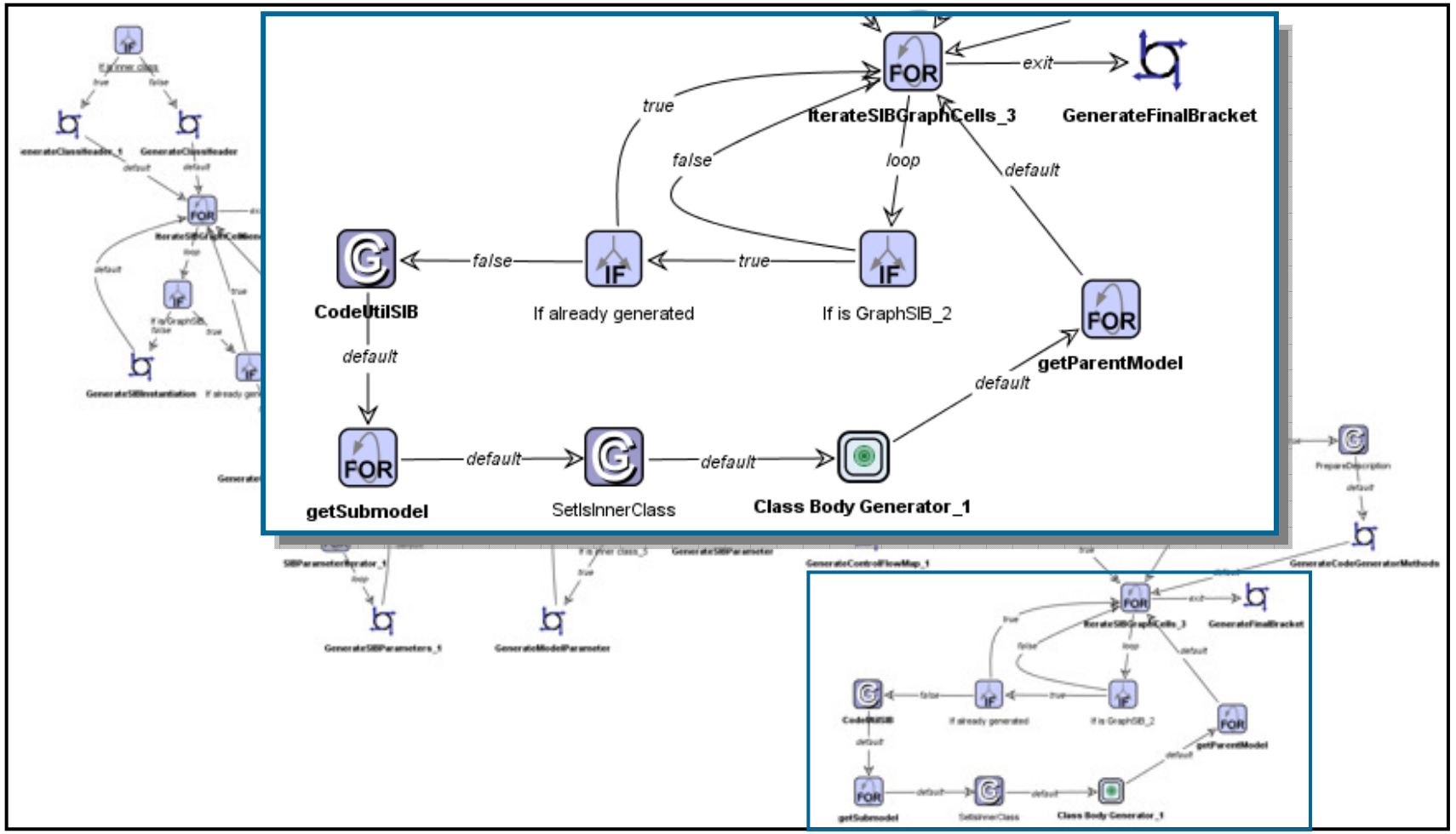
- **Tracer**
  step-wise execution of SIB-Graphs
- Enables debugging and inspection of contexts
- Fork/Join parallelism with threads



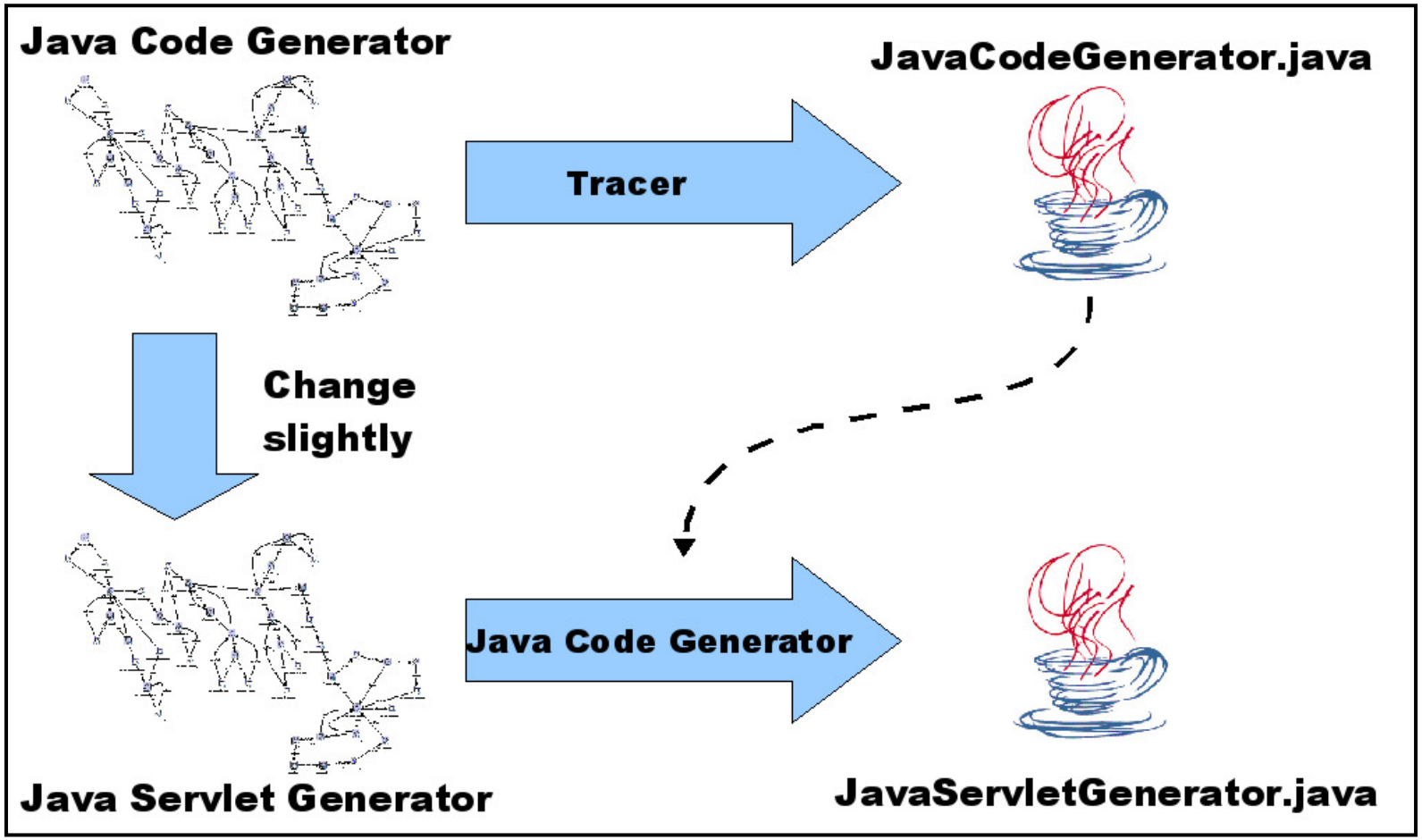
Generating code from SLGs

- **Code Generator**
  Generates code from SLGs
- Modelled using jABC
- Bootstrapped via the Tracer plug-in
- Builds Java classes or Java servlets
- C++ or J2ME code generation in progress
- LEGO Mindstorms RCX

Generating code from SLGs



Generating code from SLGs



Conclusion

- jABC as an LPC-based development method
- Improved validation technology
- Application domains cover
  - Supply chain management (IKEA)
  - Modelling and Execution of Bio-Informatics workflows
  - Semantic Web Service Challenge
  - Data-Flow Analysis of Java programs
  - Management framework for remote intelligent configuration of systems

Thank you for your time!

- jABC Framework
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  Universität Dortmund
  http://www.ls-5.de
- Chair of Software and Service Engineering
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