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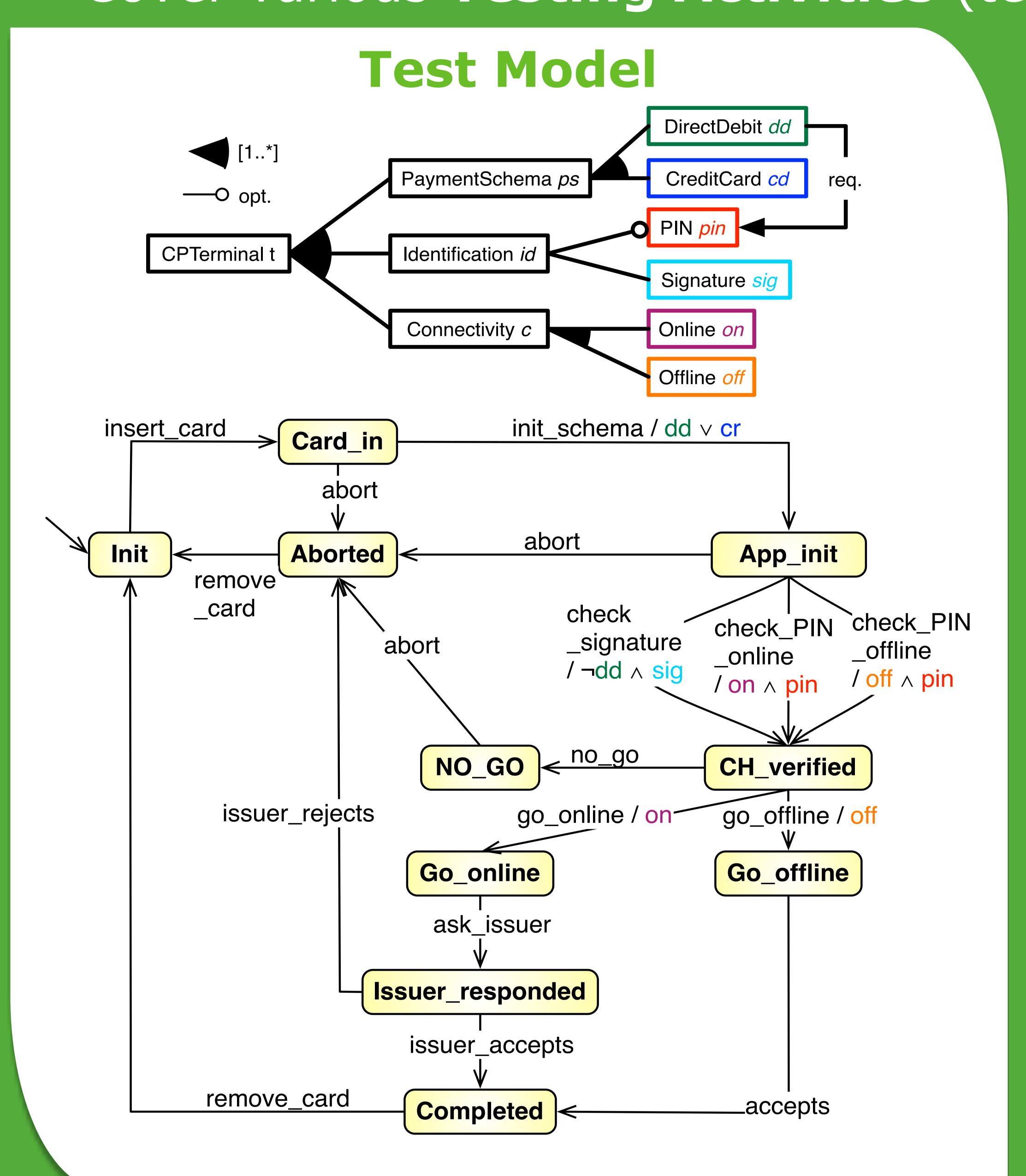
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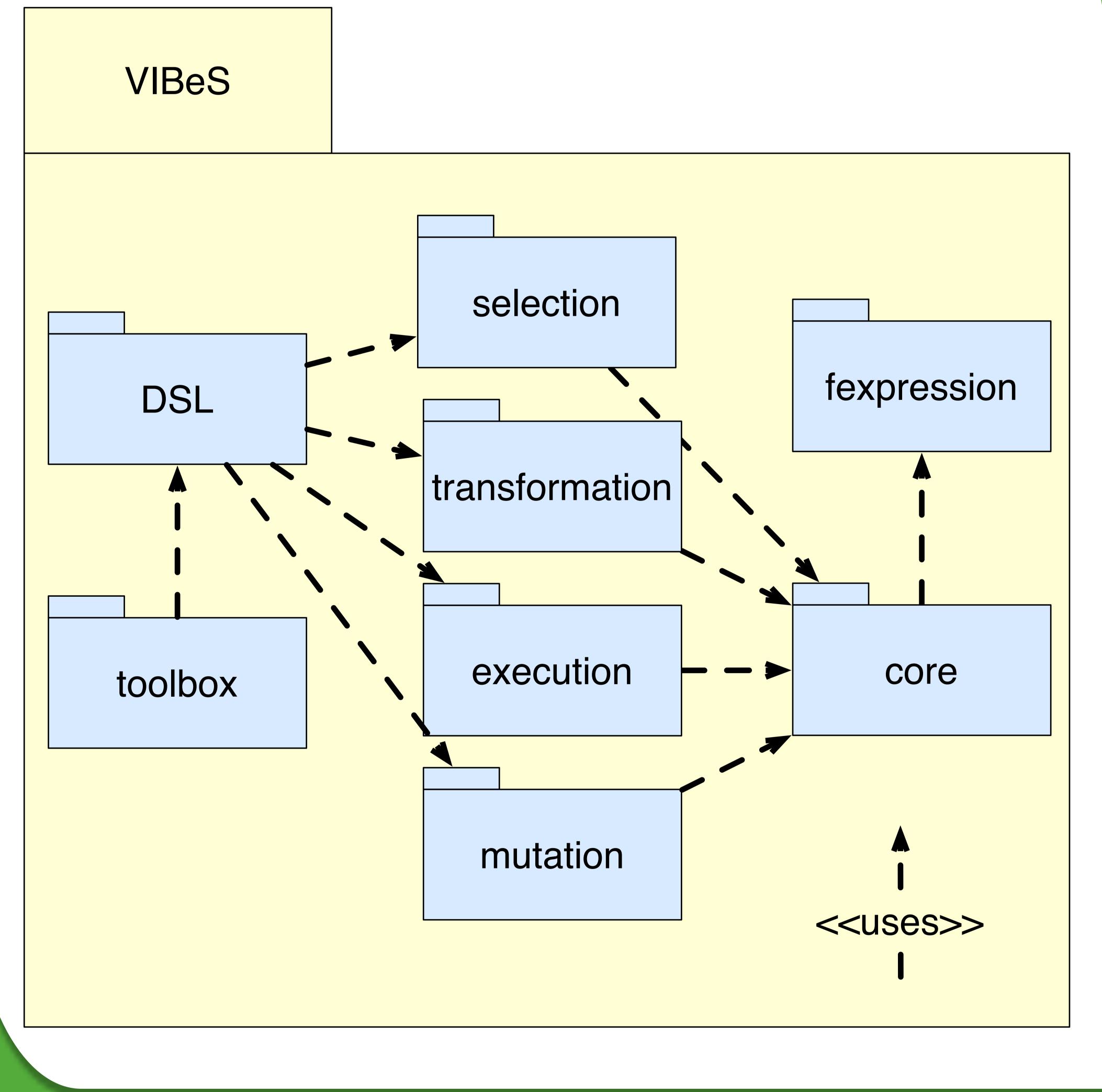
# Behavioral Model-Based Testing of Variability Intensive Systems

Xavier Devroey, Gilles Perrouin, Pierre-Yves Schobbens, Patrick Heymans

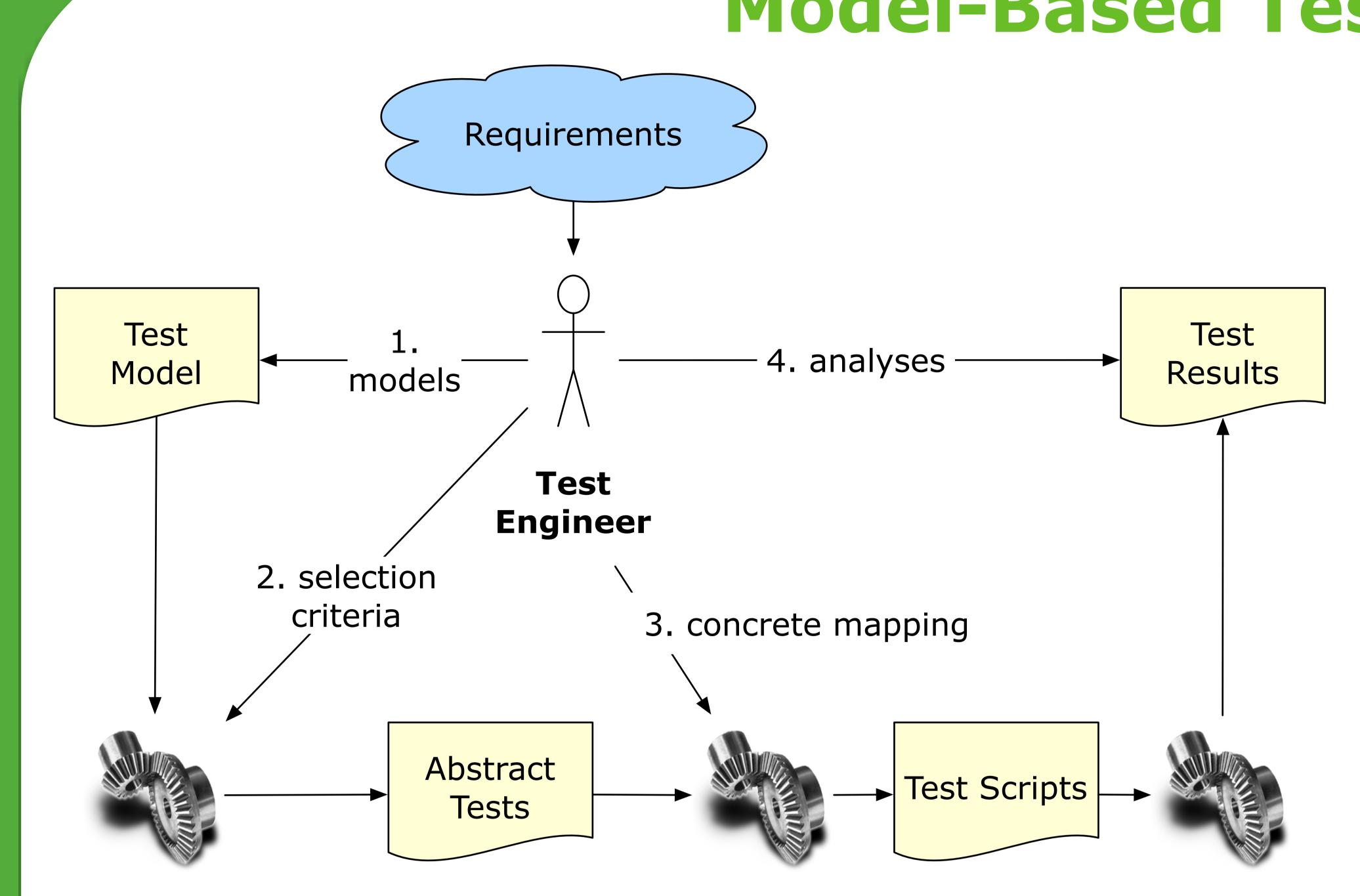
- Focus on Variability-Intensive Behavioural Models (software product lines, plugin-based systems, etc.)
- Formal Foundations (Featured Transition Systems) suitable for Analysis and Checking
- Combining Model-checking and Test-case Generation techniques in VIBeS Framework
- Cover various **Testing Activities** (test-case seleciton, prioritization, mutation assessment, etc.)



# Variability Intensive system Behavioural teSting Framework



# Model-Based Testing Process



- 1. Models definition (Java DSL)
- 2. Selection criteria definition
- Maximizing
- Structural coverage (state, transition, paths, ...) [2,3]
- Usage coverage (based on a usage model) [4]Dissimilarity measure (based on distance def.)
- Number of mutants killed by the tests [1]
- Minimizing
  - Number of test cases in the test set [3]
  - Number of valid configurations needed by the test set [3]
- 3. Concrete mapping definition (TBD)
- Under Test 4. Tests results analysis (TBD)

## Models Def.

Test Script

Generator

## Featured Transition System Java DSL

public class CPTerminalFts extends
 FeaturedTransitionSystemDefinition {
 @Override
 protected void define() {
 initial("i");
 from("i").action("insert\_card")
 .to("CardIn");
 from("cardIn").action("init\_schema")
 .fexpr("dd || cr").to("App\_init");
 ...
}

## Feature Model

Test Case

Generator

Boolean Conjunctive Normal Form (CNF) in DIMACS format used as input to SAT and BDD solvers

- Goals: Quality Assessment (QA)
- Tester: QA of a set of abstract test cases
- Researcher: QA of a test case selection method

Model Based Mutation Testing

- Mutant = Test Model with injected fault(s)
- Result of the application of a mutation operator
- Act. Exchange, State Missing, Trans. Dest. Exchange, etc.
- Execution of the test cases on the mutants

Number of mutants detectedMutation score =

Total number of mutants

# Selection Criteria Def.

## Structural coverage

FeaturedTransitionSystem fts =
 new CPTerminalFts().getTransitionSystem();

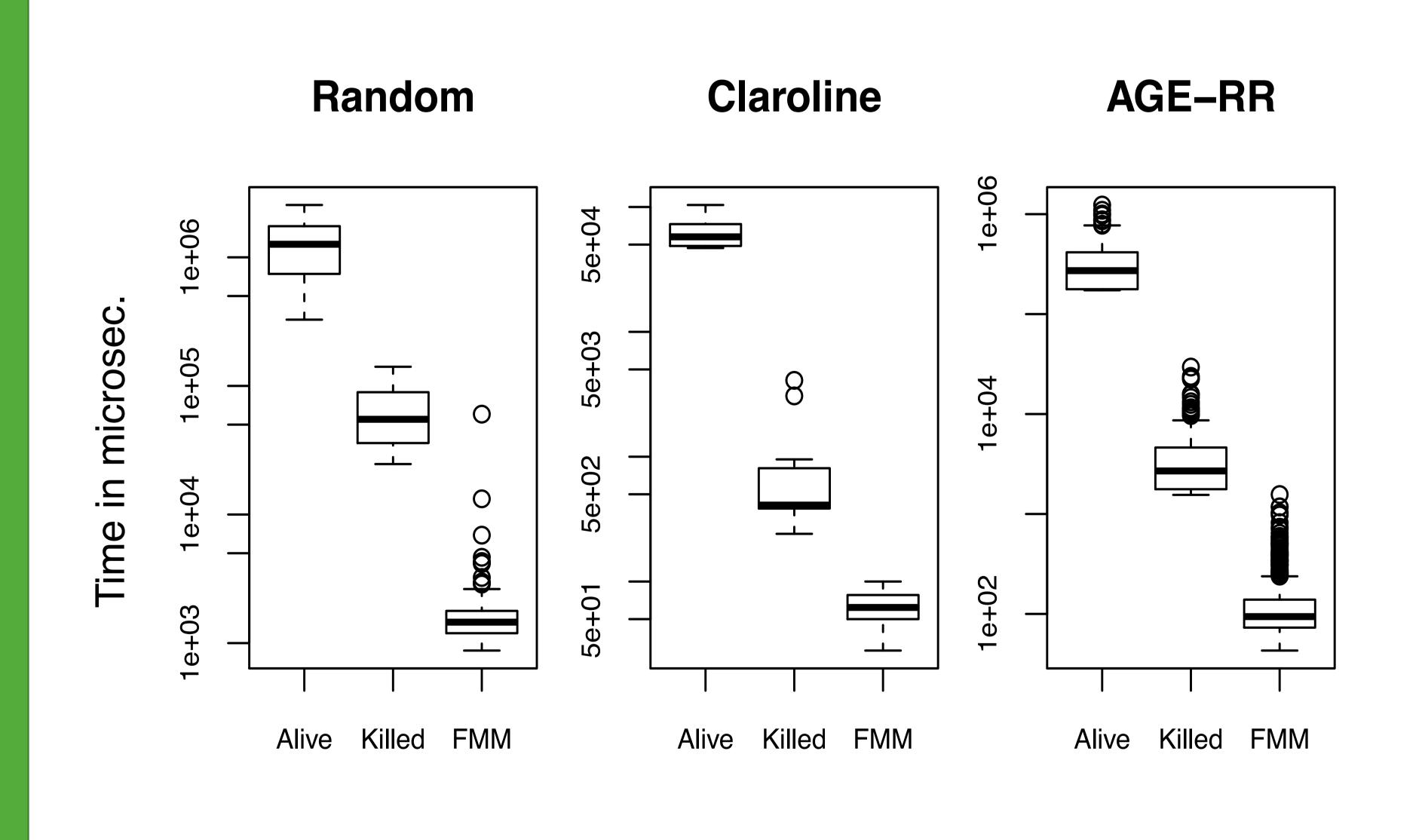
SolverFacade solver =
 new Sat4JSolverFacade(dimacsFile);

TestSet set = allStatesSelection(fts, solver);

## Dissimilarity measure maximization

set = dissimilarLocalMaximumDistance(fts,
 solver, nbrTestCases, time);
...
set = dissimilarGlobalMaximumDistance(fts,
 solver, nbrTestCases, time);

# Mutant Execution using Featured Mutants Model



# Future Work

- Higher order and equivalent mutants detect./gen.
- Test cases generation using counter examples in ProVeLines FTS model checker
- Abstract test cases concretization
- Empirical assessment on an industrial case study

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